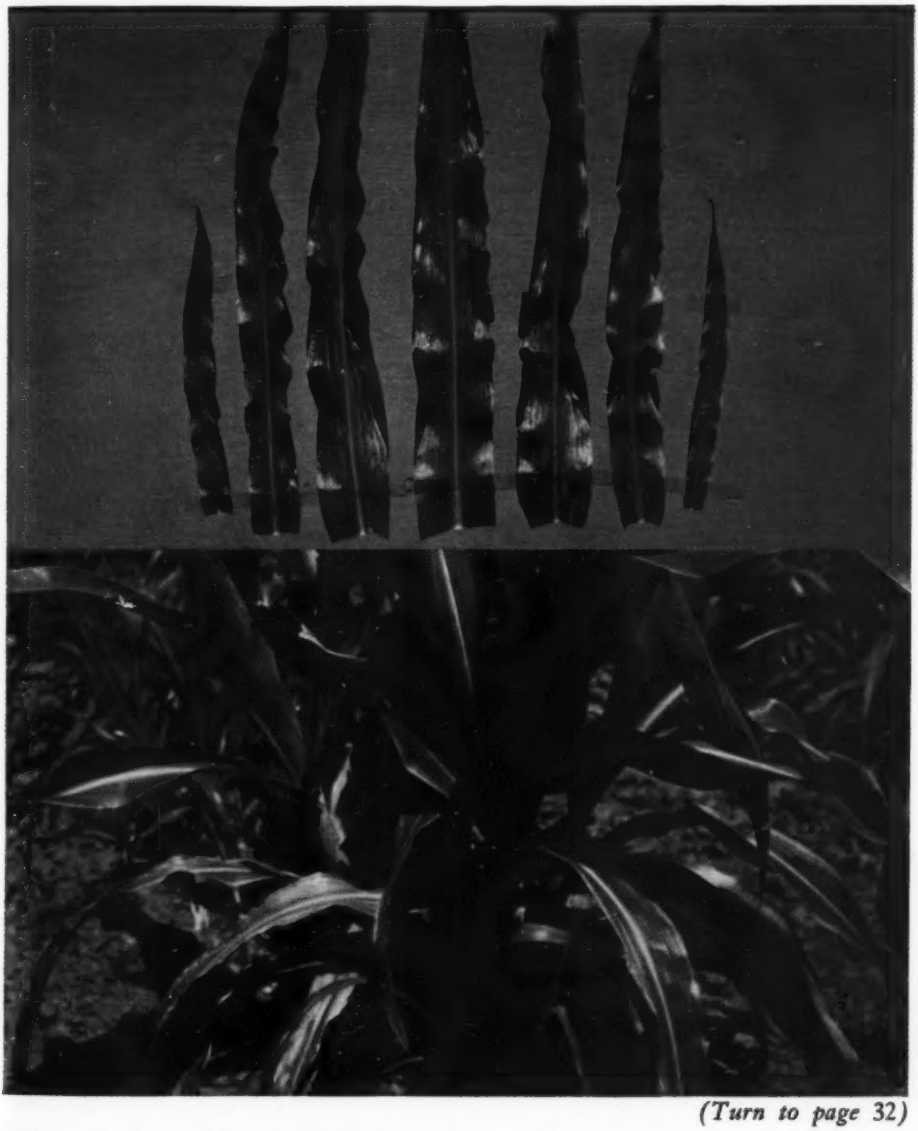
Better Crops WITH PLANT FOOD

January 1956 10 Cents



(Turn to page 32)

The Pocket Book of Agriculture

PAY DIRT

for pottery or pumpkins

In 1862, when John W. Searles, a prospector, staked mining claims on Searles Lake in California's Mojave Desert, he little knew he had discovered the richest natural deposit of *diversified* chemicals the world has ever known. In ensuing years triumphs in chemical engineering have enabled American Potash and Chemical Corporation to win from this vast dry lake bed millions of tons of basic chemicals vital to twentieth century life . . . POTASH, one of the three plant foods necessary to maintain our agricultural economy, BORAX, BORIC ACID, SODA ASH, SALT CAKE, BROMINE and LITHIUM CARBONATE used in the manufacture of glassware, ceramics, paper, enamelware and a countless array of consumer products. Constant improvement of the company's manufacturing processes at Trona, coupled with enlarged and modern research and development facilities, guarantee you a uniform and high quality source of supply.

American Potash & Chemical Corporation

TRONA
INDUSTRIAL AND AGRICULTURAL CHEMICALS

Offices • 3030 West Sixth Street, Los Angeles 54, California
• 99 Park Avenue, New York 16, New York
• 214 Walton Building, Atlanta 3, Georgia
Plants • Trona and Los Angeles, California

• BORAX • POTASH • SODA ASH • SALT CAKE • LITHIUM & BROMINE CHEMICALS
and a diversified line of specialized AGRICULTURAL, REFRIGERANT and INDUSTRIAL CHEMICALS

Better Crops with PLANT FOOD

The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

Editorial Office: 1102 16th Street, N. W., Washington 6, D. C.

VOLUME XL NO. 1

TABLE OF CONTENTS, JANUARY 1956

Rails and the Ruralite 3
Jeff Pays Tribute to Railroads

Establishing and Maintaining Alfalfa 6
R. E. Blaser's Recommended Practices

A Successful Corn Crop on the Same Land Every Year Is a Possibility 13
H. J. Snider Tells Why

Use of Radioactive Potassium in Soil-plant Studies 15
A. Wallace and R. L. Smith Report Their Findings

Producing Sugar Cane in the Caribbean Area 21
J. W. Sargent Discusses the Enterprise

Certain Practices Are Important for Successful Pecan Production 23
Chesley Hines Places the Emphasis

The American Potash Institute, Inc.
1102 16th Street, N. W., Washington 6, D. C.

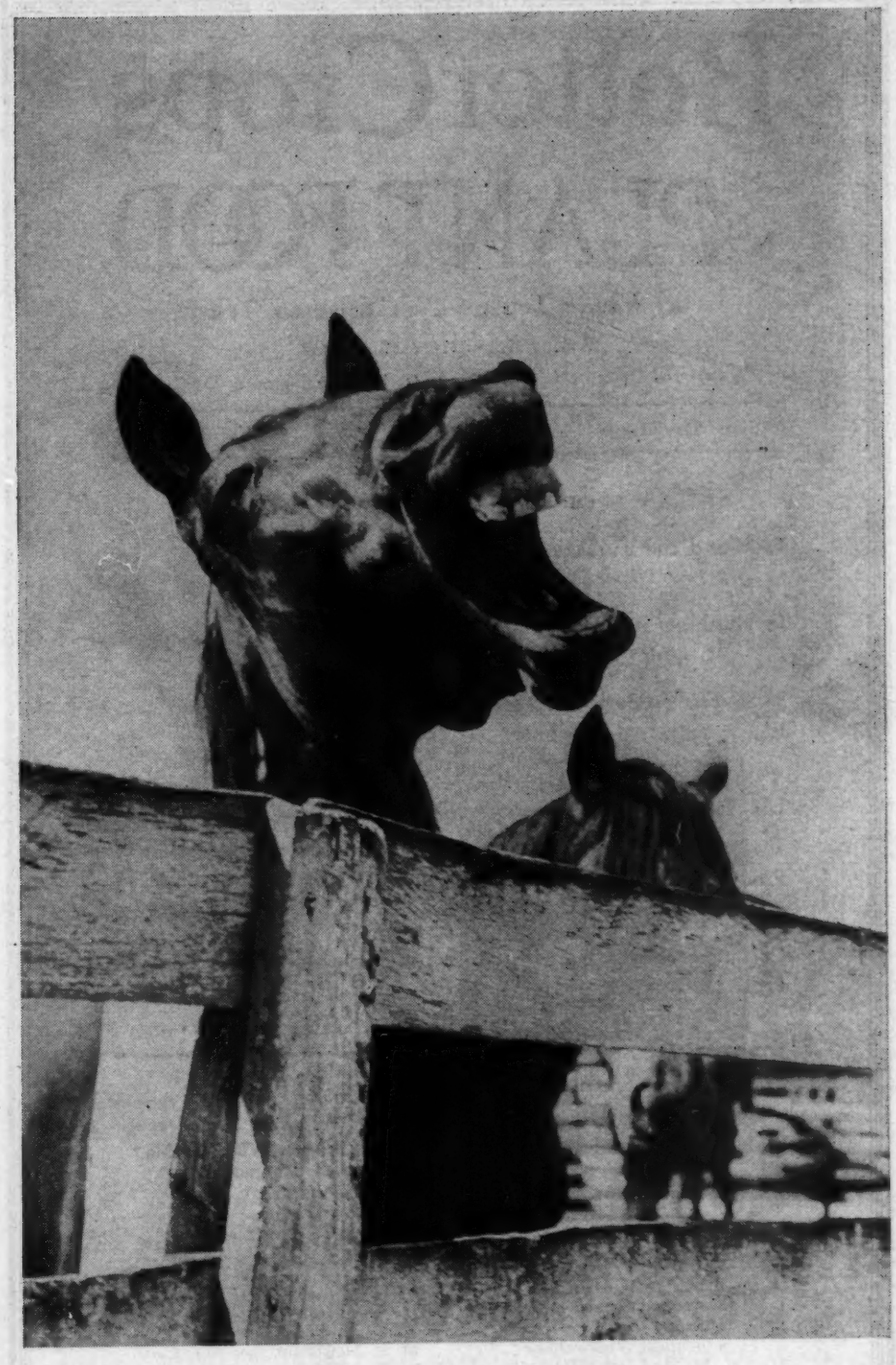
Member Companies: American Potash & Chemical Corporation
Duval Sulphur & Potash Company
Potash Company of America
Southwest Potash Corporation
United States Potash Company

Washington Staff

H. B. Mann, *President*
J. W. Turrentine, *President Emeritus*
J. D. Romaine, *Vice Pres. and Secy.*
R. H. Stinchfield, *Publications*
Mrs. H. N. Hudgins, *Librarian*

Branch Managers

E. T. York, *Washington, D. C.*
J. F. Reed, *Atlanta, Ga.*
W. L. Nelson, *Lafayette, Ind.*
M. E. McCollam, *San Jose, Calif.*
R. P. Pennington, *Burlington, Ont.*



Winter Boredom

Better Crops with PLANT FOOD

PUBLISHED BY THE AMERICAN POTASH INSTITUTE, INC., 1102 SIXTEENTH STREET, N.W., WASHINGTON 6, D. C., SUBSCRIPTION, $1.00 FOR 12 ISSUES; 10¢ PER COPY. COPYRIGHT, 1956, BY THE AMERICAN POTASH INSTITUTE, INC.

VOL. XL WASHINGTON, D. C., JANUARY 1956 No. 1

We're in debt to . . .

Rails and the Ruralite

Jeff McDermid

(ELWOOD R. MCINTYRE)

AGRICULTURE has almost dispensed with the draft horse, but the iron horse is still a mighty factor in the assurance of dependable in and out transportation to the country town supply stations that serve as the sinews of an era when one good farmer feeds over 15 others besides himself. Fellows of my vintage were raised either in a railroad town or up and beyond the hills in some hamlet reached by the stage line and the star route. Visions of ambitious canal builders and huge federal "national road" projects had in our day broken down and been laid aside because the expanding rails served our wants sufficiently for the times.

Farm wagons and stage lines hauled by teams brought the raw materials from the back country down to the closest railway freight depot and landed dusty and expectant passengers at the busy ticket office where we youngsters listened with awe to the staccato tick-tapping of the wonderful electric telegraph, manipulated by the key man of travel lore who always wore sleeve protectors and celluloid eyeshade. This important local hero could sell you a ticket to the World's Columbian Exposition or just fifteen miles to Beetown, gathering place for your clansmen when celebrating national or domestic anniversaries. The only time we ever saw him flustered was when his son and twenty other lads boarded the cars at our town for the sake of "Cuba libre" in 1898. It might have been this unaccustomed business or a little filial sentiment. Or some of those confounded cinders got into his eyes.

I resided with my folks on the edge of a rather notable railroad town, which was a division point as well. One other hero besides the ticket agent and the yardmaster pleased our fancy. He was the father of a favorite chum of mine. Once in a great while he would permit us to stand for a few moments on the top steps at the doorway of his wide-windowed shack. It was elevated on high stilts, and the big room had many heavy lever arms penetrating the floor so that Mr. Fish could throw the switches up the tracks both ways for the incoming or outbound trains. Mr. Fish had to be careful. He had to stay sober and awake. It was all a mechanical proposition, and I guess he often went home pretty tuckered out, keeping all those tons of coal and cattle and cash-paying customers right side up. I never knew what wages Mr. Fish got, but a lot of people owed him plenty for wearing himself out doing what the automatic switches and electronic contrivances perform today.

From Mr. Fish's perch where he watched for Old No. 6 tearing up the west track you could see the blue outline of Bender's Hill. To go beyond Bender's Hill and away outside our valley was mostly unthought of, because a kid's world reached no farther than that in those days. Some of us kids used to go down by the tracks with our dogs and wait. We wanted to see the Pioneer Limited roar by us, all in a blur of smoke and sparks.

NONE of us had ever been very far on a railroad train, and we wondered how it felt to travel to distant places and see so many new things and maybe make some new friends somewhere. I used to wonder if the passengers we saw reading and eating on Old No. 5 ever really saw our valley, or if they glanced out at it maybe and thought it looked Godforsaken and lonely. But since then, I can tell you, a lot of us fellows from the valley have hustled up and traveled far beyond Bender's Hill in our time. The strange point about it is that things were not so much different after all, and we did not find many great deeds to do or conquests to make after we explored what was beyond.

All in all, people were much the same and life had all its ups and downs out there beyond our valley, just like it was on this side of Bender's Hill. I noticed that a lot of the sensible and workable things we learned to do fairly well as kids came in mighty handy and useful during our travels outside the valley. But a kid always thinks of the marvels and the glories he can see and hear and learn about in other places. By and by he finds out that the shining rails he used to look at toward the sunset are always coming back towards our valley —instead of leaving it forever, like we thought when we watched the cars disappear beyond Bender's Hill.

SO, my chums, we come right back to the old place we started from, where the gadgets are changed but the folks are not, and you begin to ponder a little about the services the old railroaders gave us years ago—almost forgotten sometimes in these days of highway speeding and push-button controls.

In a way, our communities off in the country are in somewhat the same shape as the modernized farmer. Let anything happen to the juice or the fuel, or if a big universal breakdown should occur, the old horse would come in handy. Only there "ain't any." In the same way, our isolated communities might need some real help from the railways in an emergency—but in this case we still have the original power left in bigger and better iron horses. It's a continuous history, not the end of an era like farms have gone through with their fine old teams.

Too many of our students get an impression that the old-time farm communities were always in a rumpus with the railroads, and they look back into the ripsnorting campaigns of the Populists and the Grangers. They imagine

that the farmers were always being sandbagged with excessive freight rates and warehouse combinations by private capital and subjected to monopoly through protective tariffs.

WE would be silly to try and hide any historical mischance or temporary period of unwise management, but the sound way is to turn over to the other side of the ledger and look into the many good ways that the railroads helped build townships, counties, and states into prosperous agricultural zones. Our Western and Midwestern trunk railways, especially, learned through rural experience that anything Vanderbilt had said about the "public be damned" theory was contrary to their own philosophy. Rural-minded road supervisors often had farm backgrounds and they asked themselves what good it was to reach out and run threads of tracks into virgin country unless they used the public as partners in its progressive development. This same era of pioneer development in turn caused thousands of new towns to be built and its influence surged back along the right of way to create the industrial hives of our biggest cities.

Many of our present railroads have their own history books. Each of them usually has a chapter or two about the agricultural education and service work performed in its territory. The Great Northern, the Northern Pacific, the Union Pacific, the Sante Fe, the Milwaukee Road, the Baltimore & Ohio, the Chicago & Northwestern, the Chicago & Alton, the Burlington road, and many more, have some outstanding memoirs to show in regard to farms and farming. But for this record, which must be brief, let's use the Illinois Central because it has so many "firsts" in this field and stands for the faith in rural achievement that animates our best railway policies.

THE Illinois Central was the first land-grant railway in America. Taking the years in the early fifties in which colonization, land sales, and agricultural promotion started in its offices, it can also be claimed that the I. C. began its farm development programs a few years before there was any land-grant college of agriculture in existence.

Probably much of this zest for agricultural education and extension work which has animated the policies of the road harks back to the farseeing Massachusetts man who became head of the I. C. in the middle fifties. He was William H. Osborne, who operated a big demonstration farm near Chatsworth, Illinois, and ran experiments in fruits and vegetables, grain and livestock. Moreover, his successor as I. C. president in the decade right after the Civil War, John M. Douglas, pushed forward the agricultural and horticultural development with renewed vigor. Mr. Douglas also owned a Shorthorn farm in Illinois and imported some of the best early bulls for use in improving the bloodlines of Midwest herds.

One of the first excursion trains that transported farm journal editors and writers to witness expanding farm production was run soon after the war, to take in the marvelous orchard and strawberry plantations centered in Little Egypt that were largely the result of I. C. efforts and market promotion campaigns. On this same trip the chief spokesman and authority in fruit production who went along with the editors was M. L. Dunlap, widely read

(*Turn to page* 49)

Establishing and Maintaining ALFALFA*

By R. E. Blaser

Virginia Agricultural Experiment Station, Blacksburg, Virginia

IT IS somewhat easier to establish stands of alfalfa than of other small-seeded forage crop legumes; however, alfalfa demands a rather specific root environment. The successful establishment of alfalfa depends upon the following: (1) Well-drained soils with good moisture-holding capacity, (2) plenty of lime and fertilizer applied uniformly, (3) a good seedbed that is rather free of competitive weed seeds, (4) seeding during favorable periods and not too late in spring or summer, (5) management of companion crops and mowing weeds, (6) use of compatible mixtures, (7) good seeding methods, (8) inoculation of seed, and (9) use of adapted varieties.

Soils, Liming, and Fertilization

In Virginia, alfalfa has been productive on rather sandy as well as on heavier textured soils. Alfalfa has a deep taproot system that requires more soil oxygen than many forage plants. These conditions are found in well-aerated soils that do not have a high water table or poor drainage due to soil structure. If soil conditions favor deep root penetration, alfalfa is very productive even during dry periods. When comparing alfalfa with other grasses and legumes, it requires as much or more moisture per pound of dry matter; but alfalfa is drought-tolerant because of its deep root system. It is therefore imperative to select soils that are deep and well-drained for establishing new alfalfa seedings.

* This research was partially financed by the "Old Dominion Foundation."

Alfalfa has a high lime and soil pH requirement. It is best to lime the soil to a pH value of about 6.8 well in advance of alfalfa planting time. In experiments, growth and nodulation of alfalfa were very poor on an acid soil at pH 5.5. In field plantings poor survival and low production have been found to be associated with acid soil conditions.

Eastern soils are too low in phosphorus, potassium, and boron to grow good alfalfa. Soils do differ in fertilizer requirements for good alfalfa growth, as shown in Table I. In an experiment on a Chester soil in Northern Piedmont, potassium was applied liberally, but P_2O_5 applications varied from none to 400 pounds of P_2O_5 per acre. The fertilizer materials were applied in August and the yields were taken the following year. The yields were as follows: No P_2O_5—1.95 tons; 50 pounds of P_2O_5—3.35 tons; 100 pounds of P_2O_5—3.68 tons; 200 pounds of P_2O_5—3.87 tons; and with 400 pounds of P_2O_5 per acre the yield averaged 5.20 tons of hay. The yield increases from phosphorus fertilizer on a Groseclose soil in a limestone valley near Blacksburg were not as large as those obtained in Northern Virginia. Without phosphorus on this limestone soil the yield was 2.66 tons of hay per acre as compared with 2.74, 2.79, 2.95, and 3.18 tons of hay per acre when 50, 100, 200, and 400 pounds of P_2O_5 were applied.

The potassium requirements for establishing alfalfa were also studied on the two soils mentioned above. In this phase of the experiments, phosphorus

TABLE I.—THE YIELDS OF AN ALFALFA-ORCHARD GRASS MIXTURE AS INFLUENCED BY THE AMOUNT OF PHOSPHORUS AND POTASSIUM APPLIED AT ESTABLISHMENT.

	Hay—tons per acre	
	Chester soil in Northern Piedmont	Groseclose soil in Limestone Valley
P_2O_5 applied Lbs. per acre	First-year yields due to phosphorus	
0	1.95	2.66
50	3.35	2.74
100	3.68	2.79
200	3.87	2.95
400	4.20	3.18
K_2O applied Lbs. per acre	First-year yields due to potassium	
0	4.01	1.10
50	....	2.42
100	4.13	3.10
200	4.22	3.22
400	3.84	3.50

was applied liberally and adequately with all of the potassium treatments. On the limestone soil near Blacksburg, there were pronounced yield increases as a result of potassium applied in the establishing fertilization treatments. The yields of an alfalfa-orchard grass mixture for different K_2O treatments were as follows: No K_2O—1.70 tons; 50 pounds of K_2O—2.42 tons; 100 pounds of K_2O—3.10 tons; 200 pounds of K_2O—3.22 tons; and with 400 pounds of K_2O per acre 3.50 tons per acre. On a Chester soil, the responses from potassium fertilizers applied at establishment were not significant during the first productive year. The yield without potassium on this soil was 4.10 tons of hay per acre as compared with yields ranging between 3.84 and 4.22 tons of hay per acre where 100 to 400 pounds of K_2O were applied. Although potassium was not necessary for establishment on the Chester soil, in this same experiment potassium has been found necessary for maintenance.

The growth responses of alfalfa from boron fertilization vary with soil conditions; however, in Virginia boron is recommended for all alfalfa seedings. In experiments and fields located on Piedmont soils, alfalfa could not compete with grasses, legumes, and weeds unless boron was applied. Boron fertilization also improved alfalfa growth and its aggressiveness toward forage and weedy plants in an experiment on a limestone soil near Blacksburg. In general, alfalfa growth is stimulated less by boron fertilization on soils in limestone regions than in Piedmont soils in Virginia.

Excellent stands and growth of alfalfa have been obtained by applying 800 pounds or more of a 2-12-12, 0-14-14, or similar fertilizer with borax. Lime and fertilizers must be spread uniformly as these materials do not move laterally in soils. Many fields seeded to alfalfa or other forages show strips of poor and good growth because of the non-uniform spreading of lime and fertilizer. Truck distributors often miss wide strips especially when areas of the field are wet, stony, or hilly. Likewise, trucks and fertilizer distributors that spread lime and fertilizer materials laterally with revolving broadcasters do not give satisfactory distribution. Soil tests and observations show that the rate of application is two to three times higher behind the distributing disks than at several feet in a lateral direction away from distributing disks. Many soil tests made in our laboratories show that there are decided differences in soil pH, phosphorus, and potassium due to non-uniform spreading of fertilizer and lime.

Seedbeds and Seeding Dates

Alfalfa may be sown during the period of late winter to early spring or in August. In spring, it is desirable to make seedings on soils that are reasonably free of weed seeds. Weedy plants such as ragweed, plantain, and lambs-

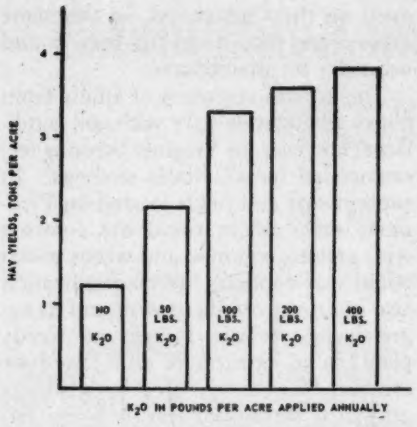


Fig. 1. The yields of an alfalfa-orchard grass mixture increased as more potash was applied up to 400 pounds of K_2O per acre. The potash was applied yearly, in late winter. The yield data are averages for a three-year period on a Groseclose limestone soil near Blacksburg. All plots were treated liberally and alike with lime, phosphorus, and boron.

quarters, that germinate during the spring season, often crowd out alfalfa. In general, the earlier spring seedings get started ahead of objectionable weeds, hence they are more apt to be successful than late spring seedings.

Seedings made during the month of August are generally more successful than alfalfa seedings made earlier or later than August. Late fall seedings are apt to fail because the seedling plants do not have time to build up large root systems and food reserves in the roots that are necessary for winter survival. Best results for August seedings of alfalfa have been obtained by preparing good seedbeds in July or earlier. Several rains on such fallowed soils to restore soil moisture along with several diskings to control weeds, followed by seedings during favorable moisture conditions in mid- or late August, have given very good stands and fast seedling growth. It is much easier to establish alfalfa during the summer time than legumes like ladino clover and red clover, and also easier than grasses. Alfalfa seedlings grow under higher temperatures and drier soil conditions than the other legumes and grasses. The rapid top and taproot growth of seedlings makes alfalfa more tolerant to dry soil conditions than other small seeded legumes.

Alfalfa seedling diseases are sometimes serious for very early and very late summer seedings if temperatures are low and there is much rainy weather. All present types of alfalfa that are adapted to the Eastern region do not have a spreading growth habit, hence one alfalfa seed grows into only one plant. Since this is true, it is important to make a good seedbed so that plant survival is high. Plowing usually makes a better seedbed than disking. A surface mulch with thorough disking is often satisfactory for summer seedings when weeds are not apt to be as harmful as for spring seedings.

Companion Crops and Mowing

Companion crops generally do more harm than good in getting alfalfa stands. The yields of grain and straw of small grain crops are on the increase because of better varieties and the use of more fertilizer. Because the small grain crops have become more productive, they compete more seriously with perennial grasses and legumes. Fall-seeded small grain crops followed with spring seedings of alfalfa are much more competitive than spring-seeded small grains. There are more alfalfa failures than successful stands where seedings of alfalfa are made during spring in fall-seeded small grain crops. Winter barley is more competitive toward inter-seeded perennial grasses and legumes than winter wheat. Early removal of the small grain crops for silage, hay, or grazing will reduce small grain competition and improve the chances of obtaining good alfalfa stands that are seeded with companion crops. In our experiments and other seedings, we have encountered few alfalfa failures when making early spring seedings with a one-half normal rate of spring oats, where the oats are grazed down quickly or cut early for hay and silage. If the oats are grazed, fields should be

Fig. 2. Alfalfa is aggressive and long-lived in an orchard grass mixture under high fertilization and good cutting management. The area shown was seeded uniformly with an alfalfa-orchard grass mixture in 1950. The picture was taken in spring 1954. The alfalfa on the right was lost because only 50 pounds of K_2O were applied each year. Potash was applied at 400 pounds per acre on the left. The experiment is located on a Groseclose limestone soil near Blacksburg.

stocked so they are grazed down in less than five days. The cattle may be introduced when oats are about 15″ high and two such grazings are usually necessary in spring. Moisture is less favorable in August than in spring, thus companion crops should not be used for summer seedings.

In new alfalfa seedings with competitive weeds, close mowing will set the weeds back more than the alfalfa. Alfalfa plants send out many shoots at or under the soil surface, whereas new shoots develop from unmowed portions of weedy plants.

Seed Mixtures

If alfalfa is to be the primary legume in a mixture, the mixture should be simple. Aggressive perennial grasses and legumes should be used sparingly. Red clover in spring seedings is very aggressive toward alfalfa and should not be used at more than 2 or 3 pounds per acre; but preferably not used at all if the land is known to be suitable for alfalfa. Ladino clover seedlings do not grow as fast as alfalfa and do not crowd alfalfa seedlings. The tall erect growth of alfalfa will also retard ladino clover

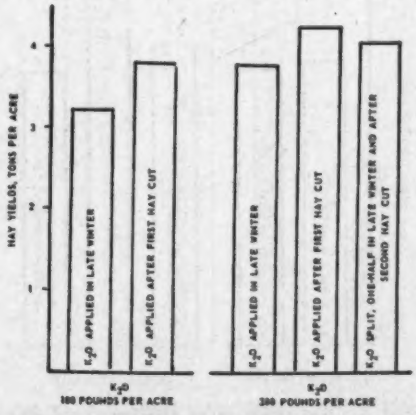


Fig. 3. Hay yields of an alfalfa-orchard grass mixture as influenced by rate and date of applying potash on a Groseclose limestone soil near Blacksburg. The data are averages for three years. All plots were treated liberally and alike with lime, phosphorus, and boron.

plants. Orchard grass seedlings start fast as compared with alfalfa in spring seedings; however, with summer seedings alfalfa seedlings start fast as compared with orchard grass. Because of these seasonal differences in seedling growth rates, orchard grass should not be seeded heavier than 2 to 4 pounds per acre in the spring with 10 to 18 pounds of alfalfa seed per acre. Orchard grass may be used at the rate of about six pounds or more of seed per acre with alfalfa in summer seedings. Like orchard grass, red clover seedlings grow slowly in summer seedings as compared with alfalfa, hence red clover is not competitive toward alfalfa in summer seedings. It is true that alfalfa is more subject to crowding by other grasses and legumes for seedings made in the spring than in the fall.

Bromegrass and timothy seedling plants have not proved to be aggressive toward alfalfa under Virginia conditions. In our experiments with alfalfa mixtures, bromegrass shows poor adaptation to Virginia because of its susceptibility to diseases. Bromegrass will produce fair yields with alfalfa in the first harvest during the spring for two or three years, after which the stand of bromegrass becomes very poor. The aftermath growth of bromegrass is also very poor when compared with orchard grass. Timothy is a single cut crop under Virginia conditions. Because of its lateness, timothy does make a desirable grass for growing with alfalfa, but its low yield and short-lived stand do not justify using it in mixtures.

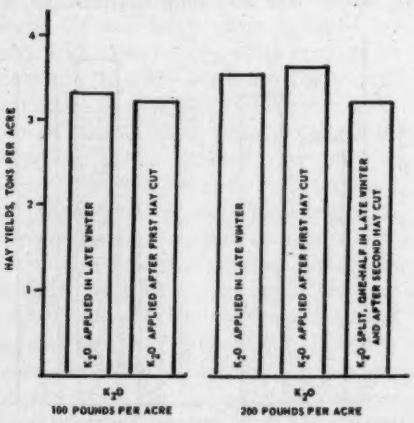


Fig. 4. Hay yields of an alfalfa-orchard grass mixture were influenced by rates and date of applying potash on a Cecil soil in the Southern Piedmont region near Charlotte Court House. The data are averages for a three-year period and all plots were treated liberally and alike with lime, phosphorus, and boron.

Method and Rate of Seeding

It is a common practice for Virginia farmers to use about 20 or more pounds of alfalfa seed per acre in pure stands, but our experiments show that seeding rates of 10 to 15 pounds per acre are about as productive as 20 pounds per acre. High seeding rates will not compensate for poor planning and poor cultural practices. By following the suggestions on establishing it is easier to obtain good stands of alfalfa than of any other legume.

The two principal methods adapted for farm seeding are broadcast and band. The best broadcast method is surface broadcasting of the seed on a firm soil, followed by cultipacking or rolling to firm the soil around the seeds. Loose soils should be cultipacked, seeded, and again cultipacked. Cultipackers with front and rear packers, where the seed is dropped in front of the rear section, are labor-saving machines. Alfalfa or alfalfa-grass mixtures may be mixed with lime or a small amount of fertilizer and seeded broadcast with a fertilizer spreader. A cultipacker hitched to the spreader will cover and pack the soil around the seed, allowing seeding in one operation.

In band seeding, the placement of seed over fertilizer bands will improve alfalfa stands on soils where fertility is low and/or where fertilizer is used at low rates. Good stands can generally be obtained with lower seeding rates for the band than for the broadcast method of seeding. Band seedings may be made with grain drills with special tube extensions from the small seed box that drop the seed behind the disks. The seed should be dropped over the

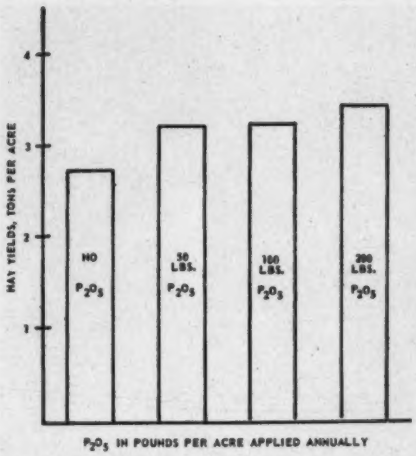


Fig. 5. Alfalfa-orchard grass yields as influenced by phosphorus fertilization on a Groseclose limestone soil near Blacksburg. The data are average yields per acre for a three-year period where lime, potassium, and boron were applied liberally and uniformly.

fertilizer bands. The fertilizer should be about one inch below the seed and most of the seeds should not be more than one inch away from the fertilizer. Covering the seed ¼ to ½ inch deep and packing the soil around the seed give the best results. This band seeding method with grain drills does not control depth of seed placement, but broadcasting the seed over the fertilizer bands on the soil surface with subsequent cultipacking has given good results. The hitching of a cultipacker behind a a grain drill for seed covering and packing has given us good results.

Inoculation and Varieties

A field of alfalfa must fix more than 200 pounds of nitrogen (equivalent to about 1,300 pounds of nitrate of soda) per acre for high hay yields and soil building. Thorough nodulation of alfalfa roots, from bacteria in the soil or on inoculated seed, is a necessity. If the soil has not grown alfalfa or sweet clover in recent years, seed inoculation is imperative. If there is an interval of one or more years between old and new alfalfa seedings on a given field, inoculation is good insurance. The methods of inoculation recommended by manufacturers of cultures have given good results. We believe that we have improved root nodulation, on fields where alfalfa was not previously grown, by using heavier inoculation rates than recommended by manufacturers of cultures. The employment of a small amount of molasses or sugar water as a nutrient and a sticking agent and thorough mixing of the seed with culture help keep the culture in contact with the seed and roots. The stickiness of this mixture is eliminated easily by adding and mixing in a finely pulverized feed or meal until all of the seeds separate.

A number of superior varieties of alfalfa (Williamsburg, Buffalo, Atlantic, Narraganset, and others) are now available for Eastern humid regions. Ranger alfalfa is wilt-resistant, but very susceptible to leaf diseases. Grazing and creeping types of alfalfa, such as Rhizoma and Nomad, produce yields about one half as high as for adapted varieties. In experiments that are three years old, the creeping alfalfas have not shown a spreading habit of growth in Virginia. Farmers should use varieties

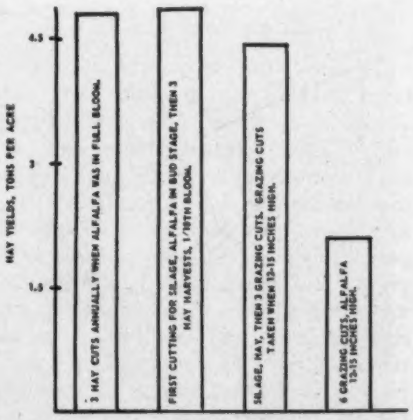

HAY YIELDS, TONS PER ACRE
4.5
3
1.5
3 HAY CUTS ANNUALLY WHEN ALFALFA WAS IN FULL BLOOM.
FIRST CUTTING FOR SILAGE, ALFALFA IN BUD STAGE, THEN 3 HAY HARVESTS, 1/10TH BLOOM.
SILAGE, HAY, THEN 3 GRAZING CUTS. GRAZING CUTS TAKEN WHEN 12-15 INCHES HIGH.
6 GRAZING CUTS, ALFALFA 12-15 INCHES HIGH.
CUTTING MANAGEMENT

Fig. 6. An alfalfa-orchard grass mixture that was cut four times each season produced more feed than three annual cuttings. Six grazing cuts reduced the yields and injured alfalfa stands (see Fig. 7). The data are average values per year for a three-year period. Alfalfa hay cut three times annually was stemmy and of low feeding value.

Fig. 7. Alfalfa alone or alfalfa-grass mixtures are long-lived and produce high yields when cut four times annually. The area shown in the picture was seeded uniformly with 18 pounds of alfalfa and 3 pounds of orchard grass per acre in spring 1950. The picture shows the first growth in 1954. The alfalfa on the left was lost because of six annual cuttings taken when the alfalfa was 12-15 inches high. The alfalfa-grass mixtures, right, averaged 4.82 tons per acre as compared with 2.08 tons, left.

that are adapted as shown by tests conducted in their respective states.

Maintaining Alfalfa

The three factors of primary importance in maintaining alfalfa are: (1) Adequate fertilizer, (2) good cutting and/or grazing management, and (3) insect control. Our experiments show that alfalfa should be topdressed annually with phosphorus and potash and perhaps borax. The amount of phosphorus and potash to apply will depend upon the fertilizer history, inherent soil characteristics, and fertilizer nutrients removed by the crop. To maintain productive fields of alfalfa, 500 to 1,000 pounds per acre of an 0-14-14 or an 0-10-20 fertilizer with borax are usually necessary. The higher fertilizer applications generally produce higher yields, and yields are often increased by applying additional potash later in the growing season.

Phosphorus and Potash Needs

An experiment to measure the length of life, grass-legume balance, and yield of an alfalfa-orchard grass mixture was established on a limestone soil near Blacksburg in 1951. The first cutting in the spring was made when orchard grass began to head and when alfalfa was in an early bud stage; and the subsequent three hay cuttings were each made when alfalfa was in one-tenth bloom. One series of plots was fertilized liberally with phosphorus, but with different amounts of potash. The yearly yields over a three-year period were as follows: No K_2O—1.24 tons; 50 pounds of K_2O—2.15 tons; 100 pounds of K_2O—3.28 tons; 200 pounds of K_2O—3.56 tons; and with 400 pounds of K_2O—3.79 tons of hay per acre, Fig. 1. When potash was limited to 50 pounds of K_2O per acre, per year, the alfalfa stand was lost, Fig. 2.

(*Turn to page* 40)

A Successful Corn Crop on the Same Land Every Year Is a Possibility

By H. J. Snider

Decatur, Illinois

SINCE the beginning of farming on this continent farmers have had in mind growing corn on the same land year after year. Some have been successful while many have met with failure because of a decline in fertility, loss of soil tilth, the removal of topsoil by erosion, and the accumulation of insects and diseases. Such a plan does offer considerable advantages, but results in past years have been so disastrous that continuous corn has been rather vigorously discouraged. The practice now begins to show some interesting results as we obtain a better understanding of the value of soil tilth and erosion control, improvement in crop fertilization, along with new ideas in planting corn and the use of adapted hybrids.

In the course of general farming when corn is grown too frequently on land, there may eventually be a decided slump in yield. On the University South Farm at Urbana in a rotation of corn, corn, oats, clover, the corn averaged 106 bu. an acre through the rotation; that is, first year corn 106 bu., second year 106 bu., oats 62 bu., and clover

Fig. 1. Continuous corn on the Morrow Plots, Urbana, Illinois, in June 1955, showing the fertilized corn on the right and the unfertilized on the left. The fertilizers consisted of 200 lbs. of N, 150 lbs. P_2O_5, and 100 lbs. K_2O per acre. In addition 5 tons of finely ground limestone per acre were added.

hay 3 tons an acre. An additional corn crop in this rotation, such as corn, corn, corn, soybeans, gave corn yields as follows: first year corn 90 bu., second year 79 bu., third year 67 bu., and soybeans 36 bu. an acre. With the additional corn in the rotation and the elimination of the clover crop, the corn yields began to slant downward at an alarming rate. This drop from 90 bu. down to 67 bu. an acre served to discourage the use of such a rotation even under central Illinois soil conditions. The land in each of these rotations was limed and given a heavy application of manure ahead of the first corn crop. With two corn crops and clover in the rotation, the corn yields were maintained at a 106 bu. level. When a third crop of corn replaced the oats crop and soybeans were the only legume, the corn yields went down to 67 bu.

In an Illinois field test which included the more modern aspects of continuous corn fertilization, the yields were maintained at an average of 76 bu. an acre over a span of 23 years. The following results were obtained on the Dixon experiment field located in Lee County in northern Illinois. The soil type is largely Muscatine silt loam. The first 10 years, with no fertilizers, corn averaged 63 bu. as compared to 55 bu. for the last 10 years of the 23-year period. When a starter fertilizer was used each year, 300 lbs. of 3-12-12, the corn for the first 10 years averaged 70 bu. and the last 10 years dropped to 60 bu. an acre. With nitrogen 120 lbs. of N. or 600 lbs. of ammonium sulphate used in addition to the starter fertilizer, the yields averaged 71 bu. the first 10 years and 65 bu. an acre the last 10 years. The pay-off came when in addition to the nitrogen and starter fertilizer there were added each year 80 lbs. of P_2O_5 in the form of superphosphate and the equivalent of 100 lbs. of K_2O as muriate of potash. This fertilizer treatment maintained an average of 76 bu. of corn throughout the 23 years of operation of the test.

Results of these field tests indicate that growing corn continuously for a long period of years is feasible and that the yields may be maintained at a high level of production. There is a probability that the amounts of fertilizer to be added each year may be adjusted by

(*Turn to page* 39)

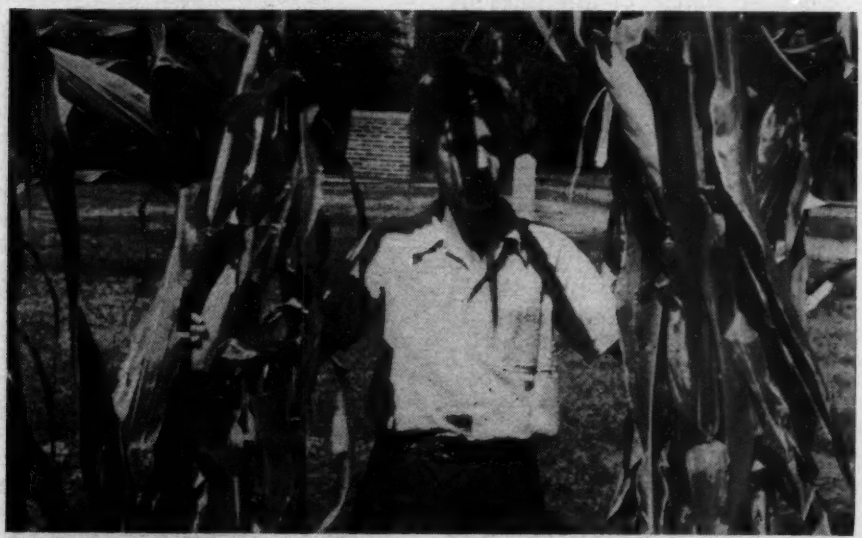


Fig. 2. Continuous corn on the Morrow Plots in September 1955 with the fertilized corn on the right and the unfertilized on the left. The larger ears on the right yielded 86 bu. per acre compared with the 36 bu. from the smaller ears on the left.

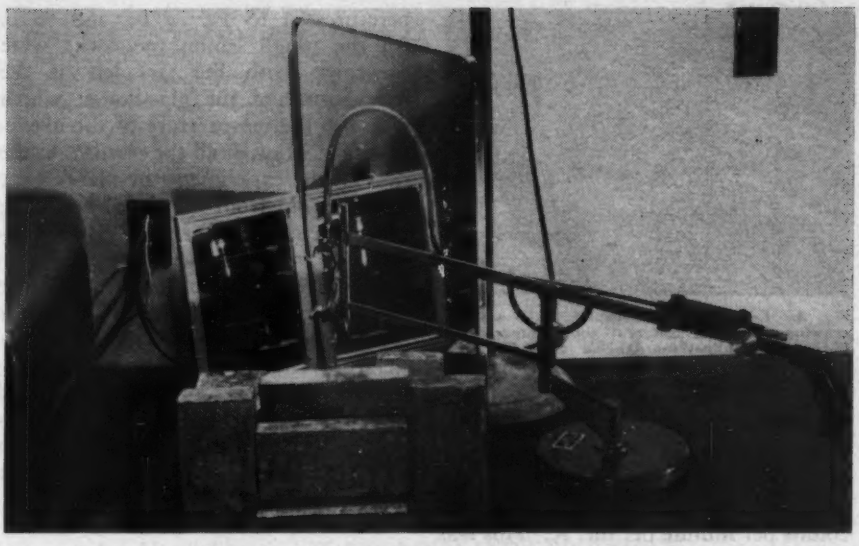


Fig. 1. Lead-brick shielding and remote control pipetting are essential in handling the initial quantity of K^{42} received in one unit from the Oak Ridge National Laboratories. After five days less than one per cent of the original activity remains, although this is sufficient for tracer soil-plant studies lasting five days.

Use of Radioactive Potassium in Soil-plant Studies

By A. Wallace and R. L. Smith

University of California, Los Angeles, California

STUDIES that concern the potassium needs of plants have not had the advantage of the tracer technique that studies with some other nutrient elements have. A relatively short-lived potassium isotope is available, however, and it can be useful in such studies.

Several plant nutrition experiments have been conducted to investigate the possibilities and limitations of using radioactive K^{42}, which has a half-life of only 12 hours. K^{42} had been successfully used previously in solution culture studies, especially when the K^{42} was produced on the campus where the study was made (7). Several K^{42} studies have been made elsewhere and we claim no originality in the procedure (4, 5, 7). We hoped to gain sufficient experience to plan additional and worthwhile experiments in the future.

A unit of K^{42} was ordered from the Oak Ridge National Laboratory, and delivery was specified for a given day three weeks in the future. The shipment was met at the airport in Los Angeles. Plants and equipment were in readiness when the isotope arrived. The 170 millicurie unit had undergone decomposition approximately equal to two half-lives before experiments were started. The plants used were those that had been grown for other experimental work and were thus well estab-

Fig. 2. Controlled temperature tanks used in growing plants at different root temperatures. Potassium applications labeled with K^{42} were made to citrus plants at root temperatures of 65, 75, and 88° F.

lished in the soil cultures. In all cases the plants were in one gallon of soil.

To 18 liters of 0.025 NK_2SO_4 enough K^{42} was added to give 2 x 10^6 counts per minute per me. K. This was added to the plants at the rate of 200 ml/gal. of soil, which gave a rate of approximately 100 lbs. K/acre 6 inches and a "contamination" of about 500 cpm/g. soil. All K^{42} treatments were started September 21, 1954. The studies will be described in some detail to illustrate a list of precautions for using K^{42} that are given at the end.

Test 1. Citrus growing in limed and nonlimed soil with different root temperatures.

One experiment was conducted on citrus growing in limed and nonlimed soil maintained at different temperatures. The plants were some used in another experiment to evaluate effects of root temperature, excess lime which commonly occurs in soil in the West, and rootstock on growth of citrus. The experiment consisted of rooted cuttings of three citrus rootstocks—Troyer citrange, trifoliate orange, and rough lemon—with Washington Navel orange scions grafted to each. Each combination was grown in one-gallon jars in noncalcareous soil and also in the same soil to which 5% $CaCO_3$ had been added. There were two replications. All except rough lemon were grown for several months with the jars suspended in baths maintained separately at temperatures of 65°F., 75°F., and 88°F. All the rough lemon rootstocks were pregrown with the jars left at the temperature of the glasshouse, which was also the temperature of the aboveground portion of all the plants. At the time of the experiment the plants were one year old from the time of making original cuttings. Forty-eight hours before the present experiment on K absorption was to begin, one third of the plants on the rough lemon rootstock were placed into each of the three temperature tanks.

Each plant was sampled twice, 12 and 88 hours after the K application, by taking 3-5 leaves from the upper portion of each plant for each sampling. The leaves were dried at 90°F., weighed, crushed into crucibles, ashed and transferred to counting planchets, and counted in a GM counter with a tube of window thickness of 1.4 mgm/cm^2.

The data for this study are tabulated in Table I. Unless there were interactions present between pairs of the variables, i.e., between rootstock and temperature, lime and temperature, or lime and rootstock, the data can be further summarized for each variable as is done in Table II. Even though data of this type are subject to inaccuracies because of isotopic exchange (1, 2), the relative differences between plants are meaningful.

Only roughly do the values for uptake after 88 hours correlate with the same differences that existed at 12 hours. For the rough lemon rootstock especially there was the tendency for the low ones at 12 hours to "catch up" with the high ones at 88 hours. This might cast considerable suspicion on very short-time experiments, although the possibility exists that the extremely short experiments may more correctly reflect the specific influence of a variable than a longer experiment. If this be true, however, the variable may be of little practical consequence.

The specific influence of rootstock appeared to be partly related to plant size (Tables I and II). This was more

TABLE I.—INFLUENCE OF SOIL TEMPERATURE AND THE PRESENCE OF 5% $CaCO_3$ IN THE SOIL ON THE CONTENT OF APPLIED K (12 AND 88 HOURS AFTER SOIL APPLICATION OF $K_2{}^{42}SO_4$) IN THE LEAVES OF WASHINGTON NAVEL ORANGE CUTTINGS THAT HAD BEEN GRAFTED TO THREE DIFFERENT ROOTSTOCK SPECIES.

Root temperature °F.	Lime treatment	K uptake after 12 hours	K uptake after 88 hours	Dry weight of plant parts			
		me. K / 1000 gram dry plant material		Leaves gram	Stem gram	Root gram	Total gram
	ROUGH LEMON ROOTSTOCK (at different temperatures only for period of K uptake)						
65	Lime	1.36	6.6	18	21	21	60
65	No lime	2.27	8.3	21	15	39	75
75	Lime	2.49	6.8	20	14	27	61
75	No lime	2.46	8.7	18	17	31	66
88	Lime	1.04	7.3	21	14	23	58
88	No lime	1.94	5.0	15	21	31	67
	TROYER CITRANGE ROOTSTOCK (maintained at different temperatures for several months)						
65	Lime	1.02	5.8	17	10	20	47
65	No lime	0.51	4.6	11	11	18	40
75	Lime	1.60	11.8	17	13	31	61
75	No lime	1.34	18.0	14	17	24	55
88	Lime	1.20	15.7	24	11	35	70
88	No lime	1.30	13.8	18	18	21	57
	TRIFOLIATE ORANGE ROOTSTOCK (maintained at different temperatures for several months)						
65	Lime	0.80	3.7	14	6	12	32
65	No lime	0.33	2.2	11	9	14	34
75	Lime	1.36	5.8	18	12	25	55
75	No lime	1.15	12.5	13	10	18	41
88	Lime	0.92	28.1	17	19	33	69
88	No lime	0.62	5.1	15	18	27	60

evident at 12 hours than for 88 hours (Table II). Not all the rootstock effects can be attributed to plant size, however, and some interesting interactions are in need of further elucidation.

On the average the excess-lime effect on potassium uptake was negligible. The amount of lime added was five per cent by weight of the soil, and without lime the pH of the soil was near neutral and contained a high percentage of exchangeable calcium. The orange leaves on rough lemon rootstock in nonlimed soil contained a little more of the applied potassium than did those in limed soil. This might be explainable on the basis of plant or root weights. Compare the ratios in Table II. For the other rootstocks the reverse was true for lime and nonlime, but this also may be explained by plant size as indicated by the ratios. This occurred because of a strong interaction of lime

TABLE II.—SUMMARY OF TABLE I TO SHOW INDIVIDUAL EFFECTS OF ROOTSTOCKS, TEMPERATURES, AND EXCESS LIME ON THE LEAF CONTENT OF APPLIED POTASSIUM.

Treatment combinations	K uptake after 12 hours	K uptake after 88 hours	Dry weight of plant parts gram/plant	
	me. K		Total	Root
	1000 gram dry plant material			
Rootstock Effect				
Rough lemon	1.92	7.1	65	29
Troyer citrange	1.16	11.6	55	25
Trifoliate orange	0.86	5.9*	49	22
Lime Effect—All Plants				
Lime	1.31	9.4	57	25
No lime	1.32	8.4	55	25
Lime Effect—Rough Lemon Alone				
Lime	1.63	6.9	60	24
No lime	2.22	7.3	69	34
Ratio lime/no lime	0.73	0.94	.87	.71
Lime Effect—Troyer Citrange and Trifoliate Orange				
Lime	1.15	11.8	56	26
No lime	0.87	9.4	48	20
Ratio lime/no lime	1.32	1.26	1.17	1.30
Temperature Effect—Rough Lemon**				
65°F	1.82	7.4	67	30
75°F	2.47	7.8	64	29
88°F	1.49	6.1	63	27
Q_{10}***65–75	1.74	1.10	.....	.....
Q_{10} 65–88	0.85	0.85	.....	.....
Q_{10} 75–88	0.50	0.77	.....	.....
Temperature Effect—Troyer Citrange and Trifoliate Orange**				
65°F	.66	4.1	38	16
75°F	1.36	12.0	53	25
88°F	1.02	11.5*	64	29
Q_{10}***65–75	3.68	6.9	1.82	2.22
Q_{10} 65–88	1.40	2.2	1.50	1.60
Q_{10} 75–88	0.67	0.9	1.40	1.23

* One sample that appeared to be out of line was omitted.

** Washington Navel orange plants on rough lemon rootstock were in the temperature tanks only for the duration of the potassium experiment. Those on Troyer citrange and trifoliate had been grown at the different temperatures for several months.

*** Q_{10} is the ratio of activity—in this case potassium uptake and also growth—for each 10 degrees centigrade difference in temperature.

and rootstock on plant size. These effects will need more careful study.

The temperature effects were real. They were not, however, as has usually been believed, the usual temperature effect (3). For the orange plants on

rough lemon rootstock, which were the same sized plants regardless of temperature, there was a slight stimulation of potassium uptake at 75°F. compared with 65°F. The magnitude of the stimulation was too small to be attributed to metabolic forces. At 88°F. there was a decrease in the absorption rates.

For the other two rootstocks which had been grown for several months at the experimental temperatures, there was a much higher increase in uptake for 75° relative to 65°. Part but not all of this can be attributed to differences in plant size. At 88° again there was a decrease in potassium uptake. This was entirely independent of plant size, since plant size for these two rootstocks was greatest at 88°. The temperature range of from 65° to 88° represents closely the range of soil temperatures during the summer months in much of the United States.

In separate experiments a large amount of data was simultaneously collected on temperature influence on both potassium and calcium uptake in solution culture studies, and these will be reported separately (6).

Test 2. Citrus rootstock species in soil with differential N treatment.

Seedlings of rough lemon, grapefruit, sweet orange, and sour orange that had been germinated in vermiculite were transplanted when five weeks old into soil in gallon crocks. The crocks all had ample drainage. There were three plants per crock and the setup was replicated three times. One crock of each species received N at the rate of 0.2 g. at three months and six months, while the others received no fertilization. At the time of K^{42} application the plants were eight months old.

Two samplings were made on these plants also. One sample was taken 15 hours and the second 71 hours after the treatment was started. The leaves were taken about four inches from the top and were dried, weighed, ashed, and counted as previously described.

After the second sampling, the plants were completely harvested, separated into roots, stems, and leaves, and the dry weight of each portion obtained. These size-data were obtained to help interpret the results.

The content of applied potassium in

Fig. 3. Counting of plant samples containing radioisotopes emitting gamma rays such as K^{42} can be greatly speeded by the use of a scintillation well-counter because of a minimum of sample preparation. Plant material can be counted directly because beta rays are screened out, making self-absorption no problem.

TABLE III.—LEAF CONTENT OF APPLIED K IN DIFFERENT 8-MONTH-OLD CITRUS SEEDLINGS IN 15 AND 71 HOURS AFTER SOIL APPLICATION OF $K_2{}^{42}SO_4$ AS INFLUENCED BY SIZE OF PLANT AND N LEVEL.

Nitrogen level	Dry Weight				15 hours		71 hours	
	Roots gram	Leaves gram	Stems gram	Total	me. K 1000 gram dry plant material	micro-eq.*	me. K 1000 gram dry plant material	micro-eq.*
Sour Orange								
High.....	18.0	17.4	9.9	45.3	1.1	17.8	2.6	42.1
Low.....	7.0	6.1	3.2	16.3	0.8	4.4	1.2	6.4
Low.....	7.0	6.1	2.8	15.9	0.7	4.5	2.3	13.9
Sweet Orange								
High.....	23.0	14.4	12.1	49.5	1.1	15.5	4.0	57.5
Low.....	10.0	5.1	3.5	18.6	0.5	2.4	1.8	9.2
Low.....	10.0	5.1	4.0	19.1	1.4	7.1	1.1	5.8
Grapefruit								
High.....	21.5	13.4	12.5	47.4	1.8	24.0	2.6	35.2
Low.....	9.5	4.0	3.3	16.8	1.3	5.4	3.0	11.9
Low.....	7.5	2.4	3.2	13.1	2.4	6.0	4.4	10.9
Rough Lemon								
High.....	19.5	16.0	13.8	49.3	5.5	87.8	3.0	48.0
Low.....	8.0	4.4	4.1	16.5	1.4	6.3	0.9	4.0
Low.....	9.0	5.0	4.3	18.3	1.6	8.1	3.2	16.1
Means of all Rootstocks								
High.....	20.5	15.3	12.1	47.9	2.4	36.3	3.1	45.7
Low.....	8.5	4.8	3.5	16.8	1.3	4.5	2.2	9.8
High/Low Ratio....	2.4	3.2	3.5	2.9	1.8	8.1	1.4	4.7

*Microequivalents of applied K present in all the leaves for each set of plants.

leaves of seedlings of the five citrus rootstock species (Table III) showed some influence of size of plant. The plants that were fertilized with nitrogen were two to four times as large as the unfertilized plants, and the uptake of radiopotassium was to a slight extent only an expression of the size of the roots and their increased contact with the soil particles rather than of the nitrogen level. Correlation coefficients calculated for the weights of roots, of leaves, and also of the whole plants with the concentration of fertilizer K appearing in the leaves, both at 15 hours and at 71 hours following application, indicated no significant relationships. The coefficients were all positive but none were significant. The posi-

(*Turn to page* 43)

Fig. 1. Sugar cane can be grown on rolling lands since it is an erosion-resisting crop.

Producing Sugar Cane in the Caribbean Area

By J. W. Sargent

Director, Soil Conservation Service, Caribbean Area, San Juan, Puerto Rico

SUGAR cane occupies 45% of the cultivated land and brings in 52% of the agricultural income in the Caribbean area. Most of the tonnage is produced on the level to rolling lands that extend, usually, a few miles inland from the coast toward the mountains. Just as there are exceptions to most rules, the mountains are no barrier and frequently the cane extends up the steep slopes to the top and down on the other side. While production-paying quantity is fairly well restricted to level and rolling land, the acreage is not so restricted.

Sugar cane is an erosion-resisting crop, otherwise a good many hills and mountains in the area already would have been leveled. It is planted only once in several years. Litter begins to accumulate on the ground as the crop begins to grow, and reaches a depth of several inches. This ground cover is far better than any winter cover crop in so far as actual cover is concerned and prevents the soil from washing. Only when the land is prepared for new planting, once in several years, is there danger of extensive soil wastage and this period of danger is short.

Sometimes the litter gets so heavy there is difficulty in harvesting the crop. Cane is cut primarily by hand with machetes and too much litter can make cutting difficult and expensive. Of course, some modern harvesting

Fig. 2. On small farms which do not have the necessary equipment the cane is loaded by hand.

equipment is being introduced and is being used, but much of the land is too rough to expect mechanized harvesting to work efficiently. Anyway, somebody has to employ an ever-increasing amount of labor.

Occasionally noxious weeds slip in and, because of their means of self-protection, make hand harvesting very expensive. We are not surprised, therefore, that burning cane fields immediately before harvesting, although still limited, is on the increase. What the results of burning will be on production, we do not yet know. Our Work Unit Conservationists are making a study of that situation. Burning does make harvesting less expensive, but it also exposes the land without cover at each harvesting time, about 1½ months out of 15. Burned cane must be harvested immediately; it begins to sour if left in the fields beyond a few hours.

Once the cane is cut, on small farms, it is loaded, by hand. On plantations it is loaded mechanically, on donkeys, carts, wagons, trucks, or trains, depending on the location and financial ability of the grower, and then starts to market. The market is the "central" or sugar mill. Cane is bought by the ton just as cotton is bought by the bale. The price is determined by the sugar content, usually a ton of clean cane equals 250 pounds of sugar. Production ranges from 10 to 100 tons of cane per acre. Heavy application of commercial fertilizer and three to five or more applications of irrigation water are common.

Sugar cane production and harvesting brings several pressing problems to the Soil Conservation Service:

1. Getting cane off of low-producing lands and getting these lands used within their capability.

2. Too many cane rows up and down the slopes. The litter hides and protects the soil but contouring helps hold the moisture and is said, in many cases, to increase production from 50 to 100%.

3. Getting landowners and occupiers loose from sugar cane harvesting long enough to get needed conservation measures planned and applied.

These are problems not because of any outspoken opposition but because, in Nos. 1 and 2, above, nobody has gone to the trouble to explain the "why" and the "how"; and in No. 3, above, because of the rush and hurry and inclination to consider only one job at a time.

Certain Practices Are Important for Successful Pecan Production

By Chesley Hines

Department of Horticulture, Mississippi State College, State College, Mississippi

TO grow pecans successfully as a commercial crop, you must follow a complete production program, including proper soil selection, use of suitable varieties, proper tree spacing, fertilization, cultivation, use of cover crops, and control of insects and diseases. If you fail to carry out one or more of these practices, you will often lose the effort and money spent on the others. Of these practices, only soil selection, varieties, tree spacing, fertilization, culture, and management will be briefly discussed here, with special emphasis on fertilization.

Pecans are best suited to fertile loam or sandy loam soils that have a deep clay subsoil. Soils having a high water table or a natural hardpan or very dry, sandy soils should never be selected for pecan growing.

When the land slopes enough to erode, terracing is just as essential in preparing it for pecans as for other crops. Before planting a new orchard on sloping land, build adequate terraces and lay out the orchard on contour lines. On such terraced land, plant rows of trees on top of wide terraces to maintain the terraces. It is possible but difficult to locate, build, and maintain terraces properly in an established orchard.

Prepare the soil for pecan planting

Fig. 1. Giant southern bur clover in delta pecan orchard of J. H. Sherard & Son, Sherard, Mississippi. ***(Courtesy, A. C. Gossard.)***

Fig. 2. Sheep grazing in pecan orchard in late spring. *(Courtesy, A. C. Gossard.)*

by deep breaking, disking, and providing surface drainage before trees are planted. Correct an artificial hardpan on old cropland by subsoiling.

Varieties

Pecan varieties have been selected mainly because of the attractiveness and quality of the nuts, the productivity of the trees, and their resistance to certain diseases and insects. The best varieties for a particular location vary, even within Mississippi, with differences in soils, climate, and the prevalence of certain diseases and insects.

From results of experimental tests and growers' experiences, the varieties recommended for Mississippi at this

Fig. 3. Cattle grazing in Base Pecan Company orchard, Lumberton, Mississippi. *(Courtesy, A. C. Gossard.)*

Fig. 4. Summer cultivation in well-cared-for bearing pecan orchard in southern Mississippi. *(Courtesy, A. C. Gossard.)*

time are:

Large type, primarily for in-the-shell retail trade—*Stuart, Desirable, Lewis*

Small type, primarily for sale to the shellers—*Curtis* and *Elliott,* under certain growing and climatic conditions

Medium-sized, general purpose type—*Farley.*

Any of these six is suitable for home production. All the recommended varieties are highly resistant to pecan scab.

Tree Spacing

The roots of pecan trees extend at least twice as far from the trunk as do the branches. For this reason trees will compete for plant food and moisture several years before the branches touch. Pecan trees usually grow to large size. At advanced ages, the roots of only four or five evenly spaced trees will occupy the soil in one acre. Eighty- to 100-foot spacing, depending on natural soil fertility, is desirable for trees after they are 25 to 30 years old. However, while the trees are young, higher yields of nuts per acre can be obtained with closer spacing.

When a pecan orchard is set out the trees may be planted at the permanent distance or closer together and part of them cut out later. Since it is hard for most people to decide to thin the stand when the time comes, this should be considered in planning the new orchard. One practical method is to place the rows 80 to 100 feet apart and plant the trees at half that distance in the rows. When the trees are 25 to 30 years old, depending on the growth they have made, they should be thinned to the permanent distance.

The need for proper tree spacing before an improved cultural, fertilization, and disease and insect control program is started in a mature orchard cannot be too strongly emphasized. Proper spacing of the trees makes the control of insects and diseases easier and more economical. In crowded orchards, only the top branches of the trees are productive. Much of the increased production in thinned orchards is from the lower branches.

Fertilization

Pecan trees require and respond to proper fertilization as much as most other crop plants. It is often thought that since only a few pecan trees are

planted to the acre, they do not need much fertilizer. By comparing the amount of plant material in the roots, wood, leaves, and nuts on an acre of bearing pecan trees with that in the roots, stalks, leaves, lint, and seed on an acre of cotton, you can see the large amount of fertilizer needed to grow vigorous trees and produce high yields of nuts.

Since pecan trees are grown on a wide variety of soil types and may need to be fertilized differently under the various conditions, no hard and fast rule can be laid down for the kind and amount of fertilizer to use. All that can be given here are general recommendations for some of the different conditions.

Soil tests show what elements are in the soil, but not what the tree can get out of it. Use the general recommendations and the results of soil tests, together with observations on the growth and yield of your trees, as guides in determining the kind and amount of fertilizer to use.

Practically all of the upland soils in the pecan belt need all three major elements—nitrogen, phosphorus, and potassium—for the best pecan tree growth and yields of nuts. Experiments show that the most economical way to fertilize pecans is through winter legumes, with the phosphorus and potassium broadcast just before or at the time of planting or shortly before a reseeding cover crop starts growth. The following spring, when the cover crops decay, the plant-food materials they have obtained from the soil and air are released in forms readily available to the trees.

Most upland soils need 300 to 400 pounds of 20 per cent superphosphate and 100 to 120 pounds of 60 per cent muriate of potash per acre for the cover crops. When more convenient, at least 500 pounds per acre of a mixed fertilizer such as 0-12-20 or 0-14-14 may be used. If the trees do not make vigorous growth and do not have dark green leaves, they probably need more nitrogen than the cover crops are supplying. In such cases, each tree should receive in the spring ⅛ to ¼ pound of ammonium nitrate, or its equivalent, for each year of age of the tree; for example, a 20-year-old tree would receive 2½ to 5 pounds.

Where it is not practicable to grow winter cover crops and apply the phosphorus and potassium in the fall, a complete fertilizer such as 6-8-8 may be applied in the spring. Usually the smallest amount of these fertilizers that should be used is two pounds per year of age of the tree, and it should be applied annually. Bearing trees 20 to 25 years old should be given at least 50 pounds per tree.

While the trees are young, either complete fertilizer or nitrogen fertilizer may be broadcast around each tree. Fertilize the area from the trunk to at least one and one-half times the length of the branches. For older trees where the branch spread covers as much as half the orchard area, broadcast the fertilizer over the entire soil surface. Complete fertilizers should be applied before the last of February and fertilizers carrying nitrogen only should be applied by or before the middle of March.

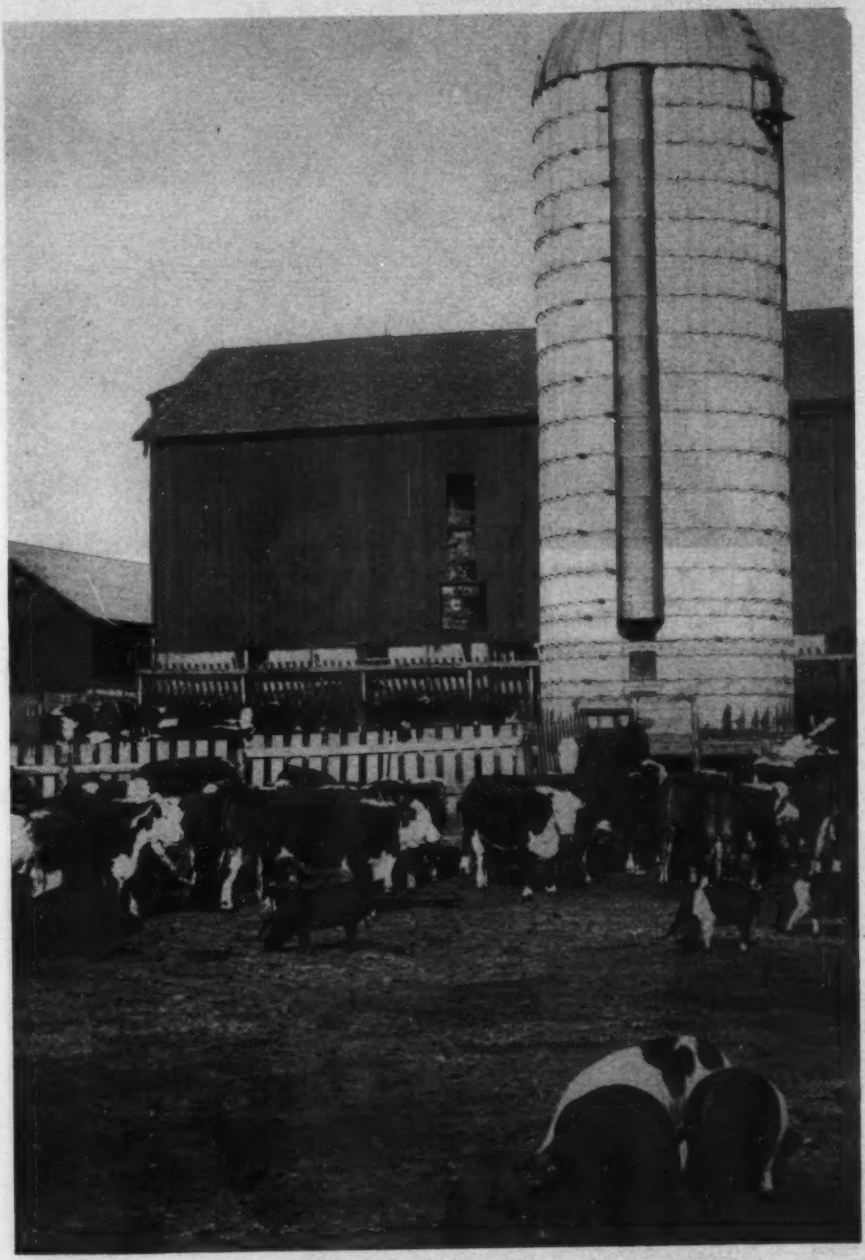
Most upland soils, in Mississippi at least, need some lime for best cover crop growth. Dolomitic limestone gives best results and is recommended for pecan orchards. Lime requirements vary so much, however, that each grower should find out from his county agent through soil tests how much dolomitic limestone is needed for his particular soil.

Pecan trees need zinc in small amounts. In some soils, an over-supply of lime will "tie up" most or all of the zinc so that the pecan trees can not use it. When this happens, the trees develop the "rosette" disease, and zinc sulphate must be applied to overcome it. Rosette also occurs on soils that are naturally low in zinc, and can be corrected in the same way.

The delta soils, except for a few areas,

(*Turn to page* 48)

PICTORIAL



The Sunny Side of the Barn

Above: A look across Grand Canyon.

Below: In the Adirondacks, N. Y.

Above: Crater Lake, National Park, Ore.

Below: In the Great Smokies, N. C.

Above: The beginning of a "few" pumpkin pies.

Below: Keeping an eye on the bird.

The Editors Talk

Losses in Agriculture

To substantiate some of the speculation on losses incurred in the production of crops, the Agricultural Research Service in 1953 appointed a committee to survey the subject. This committee undertook to work up as reliable and well-documented estimates as possible on current losses to agriculture from insects, diseases, fire, erosion, floods, etc., especially losses that might be controllable through more general application of methods already known or methods that might be worked out by additional research.

Such losses, the summary indicated, when evaluated at 1942-51 prices, averaged about 13 billion dollars' worth of goods per year, nearly one third of the potential production. Some 120 million fewer acres of cropland (ignoring pasture and range requirements) would have produced the 1942-51 volume of food, feed, and fibre production if all these causes had been eliminated.

The committee pointed out that the dollar valuation assigned to these losses is not to be interpreted as meaning the financial loss to the farmers themselves resulting from the damages described. No consideration was given to the price reductions that might have resulted from the larger crops that could have been produced if these losses had not been incurred.

Losses surveyed were roughly of two types: (1) Reduction in quantity or deterioration in quality during the production, handling, and processing of farm and forest products; and (2) deterioration in land on farms and forests, affecting annual production immediately in some cases, and over a period of years in the future. The report provided information concerning the extent of these losses. Losses in the Nation's kitchen were also included to complete the picture of what happens to agricultural products from the soil to human consumption. Losses in production and productive efficiency due to failure to use recommended management practices, such as the use of farm land for less productive crops than others that might have been chosen, were not included.

It would be interesting to know in connection with "losses that might be controllable through more general application of methods already known or methods that might be worked out by additional research" the losses that might have been avoided by a more general proper and efficient use of fertilizers. For instance, potash is known to be an important factor in the keeping quality of fruits and vegetables. How much of the one fourth of the value of strawberries shipped to market lost through decay; one fifth the value of apples; one fourth the value of lettuce, peppers, and onions; one fifth of tomatoes, celery, and sweet potatoes, etc., could have been saved by the use of more potash? How much of the loss due to diseases of crops could have been spared by appropriate use of potash and other vital plant-food elements? How much of the loss due to soil erosion could have been prevented by the proper use of fertilizers in establishing cover crops?

According to the committee's report, the annual losses from erosion alone, in

terms of the cost of replacing, through the use of commercial fertilizers, the major nutrient elements removed through soil erosion have been estimated at several billion dollars. The cost (at 1947 prices) of replacing only the nitrogen and phosphorus is estimated by the investigators at $4.3 billion, and of replacing the nitrogen, phosphorus, and one fourth of the potassium at $7.75 billion. This does not take account, however, of large supplies of these nutrients uncovered in many soils by both natural and accelerated erosion.

Losses in agriculture make fascinating reading, full of challenge to do one's part in control measures. Such participation will help in the assurance that even with non-expansible acreage we can set bounteous tables for our rapidly increasing population in the years ahead.

Our Cover Picture

A first glance at our cover picture this month would tend to identify the crop as corn. However, it is sorghum, and the nutrient deficiency symptoms illustrated are those due to lack of potash. Since corn grains and sorghum grains have the same composition and the starches manufactured from them are identical, the potash deficiency symptoms on the foliage of the two crops are similar. In young plants, growth is retarded and the young leaves are yellowish green to yellow in color. As the plants grow older and the need for potash increases, the leaves are streaked with yellow and their edges become dry and scorched.

The importance of sorghum to American agriculture has increased tremendously in the last 25 years. This primarily is due to its use in dry climates where corn will not thrive. Although the water requirement of the two is about the same, it has been shown that sorghum has twice as many secondary roots per unit of primary root as corn and only about half as much leaf surface exposed for evaporation. Unlike corn, it seems to have the ability to become almost dormant during very dry spells and then renew growth when conditions become more favorable.

Such characteristics may stem back to the origin of sorghum which is believed to be ancient Egypt where it is known to have been cultivated some 2,000 years B. C. According to J. H. Martin and J. C. Stephens of the Bureau of Plant Industry in U. S. D. A.'s Farmers' Bulletin No. 1844, the general culture of sorghum in the United States began with the introduction of a Chinese variety from France about 1855. At first most attention was devoted to the growing of sorghums as a source of sugar and sirup. Settlement of the prairie lands in the semi-arid West created a demand for drought-resistant forage crops, and now about 90% of the acreage of sweet sorghums is grown for forage and the remainder for sirup.

Sorghum thrives on a variety of soils. However, land too poor to grow corn or wheat seldom produces a satisfactory crop of sorghum. It has the reputation of being "hard on the land." The belief that cotton, corn, oats, wheat, and other crops yield less on fields that have produced a crop of sorghum the previous year than on fields preceded by most other crops is supported by rotation experiments in many states. The difference in yield is approximately 15%. On fertilization, it is said that any fertilizer known to be beneficial to corn under local conditions may be expected to be equally beneficial to sorghum.

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb. Aug.-July	Tobacco Cents per lb.	Potatoes Cents per bu. July-June	Sweet Potatoes Cents per bu. July-June	Corn Cents per bu. Oct.-Sept.	Wheat Cents per bu. July-June	Hay [1] Dollars per ton July-June	Cottonseed Dollars per ton July-June	Truck Crops ....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
1929.....	16.8	18.3	131.6	117.1	79.9	103.6	10.90	30.92	....
1930.....	9.5	12.8	91.2	108.1	59.8	67.1	11.06	22.04	....
1931.....	5.7	8.2	46.0	72.6	32.0	39.0	8.69	8.97	....
1932.....	6.5	10.5	38.0	54.2	31.9	28.2	6.20	10.33	....
1933.....	10.2	13.0	82.4	69.4	52.2	74.4	8.09	12.88	....
1934.....	12.4	21.3	44.6	79.8	81.5	84.8	13.20	33.00	....
1935.....	11.1	18.4	59.3	70.3	65.5	83.2	7.52	30.54	....
1936.....	12.4	23.6	114.2	92.9	104.4	102.5	11.20	33.36	....
1937.....	8.4	20.4	52.9	78.0	51.8	96.2	8.74	19.51	....
1938.....	8.6	19.6	55.7	69.8	48.6	56.2	6.78	21.79	....
1939.....	9.1	15.4	69.7	73.4	56.8	69.1	7.94	21.17	....
1940.....	9.9	16.0	54.1	85.4	61.8	68.2	7.59	21.73	....
1941.....	17.0	26.4	80.8	92.2	75.1	94.4	9.70	47.65	....
1942.....	19.0	36.9	117.0	118.0	91.7	110.0	10.80	45.61	....
1943.....	19.9	40.5	131.0	206.0	112.0	136.0	14.80	52.10	....
1944.....	20.7	42.0	150.0	190.0	109.0	141.0	16.50	52.70	....
1945.....	22.5	36.6	143.0	204.0	127.0	150.0	15.10	51.10	....
1946.....	32.6	38.2	124.0	218.0	156.0	191.0	16.70	72.00	....
1947.....	31.9	38.0	162.0	217.0	216.0	229.0	17.60	85.90	....
1948.....	30.4	48.2	155.0	222.0	129.0	200.0	18.45	67.20	....
1949.....	28.6	45.9	128.0	214.0	124.0	188.0	16.50	43.40	....
1950.....	40.1	51.7	91.7	173.0	153.0	200.0	16.70	86.50	....
1951.....	37.9	51.1	163.0	304.0	166.0	211.0	19.50	69.30	....
1952.....	34.6	49.9	198.0	338.0	153.0	209.0	19.95	69.60	....
1953.....	32.3	52.2	78.1	244.0	148.0	204.0	17.45	52.60	....
1954.....	33.6	51.4	123.0	216.0	143.0	214.0	17.35	60.30	....
1955									
January.....	32.51	42.4	113.0	283.0	140.0	214.0	18.75	56.80	....
February....	31.69	36.8	117.0	297.0	140.0	213.0	18.55	55.20	....
March.....	31.87	....	118.0	310.0	136.0	212.0	18.25	53.40	....
April.....	31.93	....	217.0	315.0	136.0	209.0	17.65	53.40	....
May.....	31.51	46.0	223.0	315.0	140.0	213.0	17.45	53.10	....
June.....	31.43	39.5	121.0	392.0	140.0	206.0	16.35	52.00	....
July.....	32.11	38.0	88.0	279.0	140.0	197.0	15.25	54.00	....
August.....	32.74	50.6	75.2	179.0	130.0	190.0	15.25	50.10	....
September...	33.77	51.5	71.3	142.0	124.0	192.0	15.55	43.70	....
October.....	32.83	55.0	72.3	144.0	114.0	194.0	15.75	43.50	....
November...	32.42	52.5	82.9	168.0	109.0	194.0	16.05	44.30	....
December....	31.19	57.2	81.7	203.0	115.0	195.0	16.55	45.00	....
Index Numbers (Aug. 1909–July 1914 = 100)									
1929.....	135	183	189	133	124	117	92	137	137
1930.....	77	128	131	123	93	76	93	98	128
1931.....	46	82	66	83	50	44	73	40	107
1932.....	52	105	55	62	50	43	52	46	100
1933.....	82	130	118	79	81	84	68	57	90
1934.....	100	213	64	91	127	96	111	146	94
1935.....	90	184	85	80	102	94	63	135	116
1936.....	100	236	164	106	163	116	94	148	108
1937.....	68	204	76	89	81	109	74	87	114
1938.....	69	196	80	79	76	64	57	97	96
1939.....	73	154	100	84	88	78	67	94	98
1940.....	80	160	78	97	96	77	64	96	122
1941.....	137	264	116	105	117	107	82	211	138
1942.....	153	369	168	134	143	124	91	202	178
1943.....	160	405	188	235	174	154	125	231	270
1944.....	167	420	214	216	170	160	139	234	236
1945.....	181	366	205	232	198	170	127	227	240
1946.....	263	382	178	248	212	209	141	319	217
1947.....	257	380	232	248	336	259	148	381	262
1948.....	245	482	222	253	201	226	155	298	253
1949.....	231	459	184	244	193	213	139	192	232
1950.....	323	517	132	197	238	226	141	384	211
1951.....	306	512	233	346	259	239	164	307	269
1952.....	279	499	284	385	238	236	168	309	274
1953.....	260	522	112	278	231	231	147	233	240
1954.....	270	514	176	246	223	242	146	267	228
1955									
January.....	262	424	162	322	218	242	158	252	263
February....	256	368	168	338	218	241	156	245	258
March.....	257	...	169	353	212	240	154	237	262
April.....	258	...	311	359	212	236	149	237	270
May.....	154	460	320	359	218	241	147	235	308
June.....	253	395	174	435	218	233	138	231	230
July.....	259	380	126	318	218	223	128	239	223
August.....	264	506	108	204	202	215	128	222	211
September...	272	515	102	162	193	217	131	194	230
October.....	265	550	104	164	178	219	133	193	223
November...	261	525	119	191	170	219	135	196	231
December....	252	572	117	231	179	221	139	200	231

Wholesale Prices of Phosphates and Potash * *

	Superphosphate, Baltimore, per unit	Florida land, pebble, 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports [2]	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports [2]	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports [2]	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports [2]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1929	.609	3.18	5.50	.672	.962	26.59	.610
1930	.542	3.18	5.50	.681	.973	26.92	.618
1931	.485	3.18	5.50	.681	.973	26.92	.618
1932	.458	3.18	5.50	.681	.963	26.90	.618
1933	.434	3.11	5.50	.662	.864	25.10	.601
1934	.487	3.14	5.67	.486	.751	22.49	.483
1935	.492	3.30	5.69	.415	.684	21.44	.444
1936	.476	1.85	5.50	.464	.708	22.94	.505
1937	.510	1.85	5.50	.508	.757	24.70	.556
1938	.492	1.85	5.50	.523	.774	15.17	.572
1939	.478	1.90	5.50	.521	.751	24.52	.570
1940	.516	1.90	5.50	.517	.730	24.75	.573
1941	.547	1.94	5.64	.522	.780	25.55	.367
1942	.600	2.13	6.29	.522	.810	25.74	.205
1943	.631	2.00	5.93	.522	.786	25.35	.195
1944	.645	2.10	6.10	.522	.777	25.35	.195
1945	.650	2.20	6.23	.522	.777	25.35	.195
1946	.671	2.41	6.50	.508	.769	24.70	.190
1947	.746	3.05	6.60	.432	.706	18.93	.195
1948	.764	4.27	6.60	.397	.681	14.14	.195
1949	.770	3.88	6.22	.397	.703	14.14	.195
1950	.763	3.83	5.47	.371	.716	14.33	.195
1951	.813	3.98	5.47	.401	.780	15.25	.200
1952	.849	3.98	5.47	.401	.793	15.25	.200
1953	.878	....	....	.410	.793	15.25	.200
1954	.895	....	....	.405	.791	15.27	.200
1955							
January	.895	....	....	.405	.825	16.00	.193
February	.895	....	....	.405	.825	16.00	.193
March	.895	....	....	.405	.825	16.00	.193
April	.895	....	....	.405	.825	16.00	.193
May	.895	....	....	.405	.825	16.00	.193
June	.895	....	....	.360	.720	13.45	.175
July	.895	....	....	.390	.735	14.00	.193
August	.895	....	....	.390	.735	14.00	.193
September	.895	....	....	.390	.735	14.00	.193
October	.895	....	....	.390	.735	14.00	.193
November	.895	....	....	.390	.735	14.00	.193
December	.895	....	....	.390	.735	14.00	.193
	Index Numbers (1910-14 = 100)						
1929	114	88	113	94	101	110	93
1930	101	88	113	95	102	111	94
1931	90	88	113	95	102	111	94
1932	85	88	113	95	101	111	94
1933	81	86	113	93	91	104	91
1934	91	87	110	68	79	93	74
1935	92	91	117	58	72	89	68
1936	89	51	113	65	74	95	77
1937	95	51	113	71	79	102	85
1938	92	51	113	73	81	104	87
1939	89	53	113	73	79	101	87
1940	96	53	113	72	77	102	87
1941	102	54	110	73	82	106	87
1942	112	59	129	73	85	106	84
1943	117	55	121	73	82	105	83
1944	120	58	125	73	82	105	83
1945	121	61	128	73	82	105	83
1946	125	67	133	71	81	102	82
1947	139	84	135	70	74	78	83
1948	143	118	135	67	72	58	83
1949	144	108	128	67	74	58	83
1950	142	106	112	68	75	59	83
1951	152	110	112	72	82	63	83
1952	158	110	112	72	83	63	83
1953	164	...	...	73	83	63	83
1954	167	...	...	72	83	63	83
1955							
January	167	...	...	72	87	66	83
February	167	...	...	72	87	66	83
March	167	...	...	72	87	66	83
April	167	...	...	72	87	66	83
May	167	...	...	72	87	66	83
June	167	...	...	66	76	56	80
July	167	...	...	70	77	58	82
August	167	...	...	70	77	58	82
September	167	...	...	70	77	58	82
October	167	...	...	70	77	58	82
November	167	...	...	70	77	58	82
December	167	...	...	70	77	58	82

Wholesale Prices of Ammoniates * *

	Nitrate of soda bulk per unit N	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish, scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N	High grade ground blood, 16–17 % ammonia, Chicago, bulk, per unit N
1910–14	$2.68	$2.85	$3.50	$3.53	$3.37	$3.52
1929	2.57	2.04	5.64	5.00	4.61	5.72
1930	2.47	1.81	4.78	4.96	3.79	4.58
1931	2.34	1.46	3.10	3.95	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.67	3.27
1935	1.47	1.15	4.59	3.10	3.06	3.65
1936	1.53	1.23	4.17	3.42	3.58	4.25
1937	1.63	1.32	4.91	4.66	4.04	4.80
1938	1.69	1.38	3.69	3.76	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.76	4.43
1942	1.74	1.41	6.11	5.77	5.04	6.76
1943	1.75	1.42	6.30	5.77	4.86	6.62
1944	1.75	1.42	7.68	5.77	4.86	6.71
1945	1.75	1.42	7.81	5.77	4.86	6.71
1946	1.97	1.44	11.04	7.38	6.60	9.33
1947	2.50	1.60	12.72	10.66	12.63	10.46
1948	2.86	2.03	12.94	10.59	10.84	9.85
1949	3.15	2.29	10.11	13.18	10.73	10.62
1950	3.00	1.95	11.01	11.70	10.21	9.36
1951	3.16	1.97	13.20	10.92	10.18	10.09
1952	3.34	2.09	13.95	11.27	9.72	9.16
1953	3.26	2.27	11.04	11.19	7.39	7.09
1954	3.07	2.20	11.50	11.63	9.72	9.85
1955						
January	2.98	2.18	12.00	12.35	8.32	8.32
February	2.98	2.18	11.16	12.23	8.50	8.50
March	2.98	2.18	10.47	12.45	7.82	7.82
April	2.98	2.18	9.90	12.41	6.68	6.23
May	2.98	2.16	9.97	11.92	6.19	6.25
June	2.98	2.02	9.91	11.55	6.23	5.92
July	2.98	2.02	10.01	9.43	6.68	7.14
August	2.98	2.07	9.88	11.12	7.04	6.86
September	2.98	2.05	9.29	11.60	6.75	6.53
October	2.98	2.07	9.17	13.01	7.47	7.16
November	2.98	2.07	8.71	13.10	6.14	6.23
December	2.98	2.12	9.21	12.93	5.66	6.00
	Index Numbers (1910-14 = 100)					
1929	96	72	161	142	137	162
1930	92	64	137	141	112	130
1931	88	51	89	112	63	70
1932	71	36	62	62	36	39
1933	59	39	84	81	97	71
1934	59	42	127	89	79	93
1935	57	40	131	88	91	104
1936	59	43	119	97	106	131
1937	61	46	140	132	120	122
1938	63	48	105	106	93	100
1939	63	47	115	125	115	111
1940	63	48	133	124	99	96
1941	63	49	157	151	112	126
1942	65	49	175	163	150	192
1943	65	50	180	163	144	189
1944	65	50	219	163	144	191
1945	65	50	223	163	144	191
1946	74	51	315	209	196	265
1947	93	56	363	302	374	297
1948	107	71	370	300	322	280
1949	117	80	289	373	318	302
1950	112	68	315	331	303	266
1951	118	69	377	310	302	287
1952	125	74	399	319	288	260
1953	122	80	315	317	219	201
1954	114	77	329	330	288	280
1955						
January	111	76	343	350	247	236
February	111	76	319	346	252	241
March	111	76	299	353	232	222
April	111	76	283	352	198	177
May	111	76	285	338	184	178
June	111	71	283	327	185	168
July	111	71	286	267	198	203
August	111	73	282	315	200	195
September	111	72	265	329	200	186
October	111	73	262	369	222	203
November	111	73	249	371	182	177
December	111	74	263	366	168	170

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and All Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer material‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash**
1929.....	148	150	139	114	79	146	114	97
1930.....	125	140	126	105	72	131	101	99
1931.....	87	119	107	83	62	83	90	99
1932.....	65	102	95	71	46	48	85	99
1933.....	70	104	96	70	45	71	81	95
1934.....	90	118	109	72	47	90	91	72
1935.....	109	123	117	70	45	97	92	63
1936.....	114	123	118	73	47	107	89	69
1937.....	122	130	126	81	50	129	95	75
1938.....	97	122	115	78	52	101	92	77
1939.....	95	121	112	79	51	119	89	77
1940.....	100	122	115	80	52	114	96	77
1941.....	124	130	127	86	56	130	120	77
1942.....	159	149	144	93	57	161	112	77
1943.....	193	165	151	94	57	160	117	77
1944.....	197	174	152	96	57	174	120	76
1945.....	207	180	154	97	57	175	121	76
1946.....	236	197	177	107	62	240	125	75
1947.....	276	231	222	130	74	362	139	72
1948.....	287	250	241	134	89	314	143	70
1949.....	250	240	226	137	99	319	144	70
1950.....	258	246	232	132	89	314	142	72
1951.....	302	271	258	139	93	331	152	76
1952.....	288	273	251	144	98	333	158	76
1953.....	258	262	247	139	100	269	164	77
1954.....	249	264	248	142	95	311	167	76
1955								
January...	244	264	248	140	93	297	167	77
February..	245	264	248	139	93	291	167	77
March....	244	265	248	137	93	275	167	77
April.....	247	265	248	135	93	252	167	77
May.....	244	263	248	134	93	243	167	77
June.....	243	263	248	131	90	242	167	70
July.....	237	262	248	132	90	240	167	74
August....	233	260	248	133	91	252	167	74
September.	235	259	250	132	91	244	167	74
October...	230	261	250	134	91	259	167	74
November.	225	259	250	131	91	235	167	74
December..	223	259	250	132	92	232	167	74

* U. S. D. A. figures, revised January 1950. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management, Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] **Beginning July 1949, baled hay prices reduced by $4.75 a ton to be comparable to loose hay prices previously quoted.**

[2] **Potash salts quoted F.O.B. mines; manure salts since June 1941; other carriers since June 1947. Beginning June 1954, muriate of potash quoted on both mine and port basis.**

** **Where range of prices for fertilizer material is quoted, average figure is used. The weighted average of prices actually paid for potash is lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period.**

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

"Fertilizer Recommendations for Cereal, Hay, and Pasture Crops," Dept. of Agr., Toronto, Ont., Can., Cir. 144, Rev. May 1955.

"Fertilizer Recommendations for Intertilled Crops." Dept. of Agr., Toronto, Ont., Can., Cir. 264, Oct. 1955.

"The Utilization of Poultry Manure in Strawberry Production," Agr. Exp. Sta., Univ. of Del., Newark, Del., Tech. Bul. 312, June 1955, C. W. Hitz.

"Inspection of Commercial Fertilizers," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind., Cir. 412, April 1955, F. W. Quackenbush, et al.

"Distribution of Fertilizer Sales in Kentucky, January 1, 1955 Through June 30, 1955," Agr. Exp. Sta., Univ. of Ky., Lexington, Ky., Nov. 1955.

"Fertilizing Sweet Potatoes," Agr. Ext. Serv., Univ. of Md., College Park, Md., Ft. Sh. 23, Rev. June 1955, A. A. Duncan and L. E. Scott.

"Sulfur Supplies and Requirements for Crops in Mississippi," Agr. Exp. Sta., Miss. State College, State College, Miss., Cir. 197, Aug. 1955, C. E. Bardsley, Jr. and H. V. Jordan.

"Missouri Commercial Fertilizer Inspection and Analysis, 1954," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., Bul. 653, April 1955, J. H. Longwell, R. C. Prewitt, C. W. Gehrke, and E. W. Cowan.

"Fertilizer and Lime Recommendations for New Jersey," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Cir. 568, May 1955, J. C. Anderson, et al.

"Distribution of Fertilizer in Oklahoma Counties by Grades and Material for the Period July 1, 1955 to October 1, 1955," State Dept. of Agr., Okla. City, Okla.

"Know Your Fertilizers," Agr. Ext. Serv., Okla. A. & M. College, Stillwater, Okla.

"Inspection and Analysis of Commercial Fertilizers in South Carolina," Agr. Exp. Sta., Clemson Agr. College, Clemson, S. C., Bul. 430, Oct. 1955, B. C. Cloaninger.

"Analyses of Commercial Fertilizers Sold During 1954-55," Agr. Exp. Sta., Tex. A. & M. College, College Station, Tex., Bul. 822, Sept. 1955, J. F. Fudge.

"Grain Sorghum Fertilizer Trial, Lower Rio Grande Valley, 1955," Prog. Rpt. 1823, Nov. 1955, C. A. Burleson, W. R. Cowley, J. L. Hubbard, and G. Otey.

"Wisconsin Fertilizer Statistics—1954-55," State Dept. of Agr., Madison, Wis., No. 333, Dec. 1955, W. B. Griem.

Soils

"Your Land—Learn to Judge It," Agr. Ext. Serv., Univ. of Hawaii, Honolulu, Hawaii, Ext. Cir. 351, May 1955, Z. C. Foster.

"Hardwood Tree Planting Experiments on Strip Mine Spoil Banks of Indiana," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind., Sta. Bul. 619, March 1955, D. DenUyl.

"Irrigation on Louisiana Farms," Agr. Ext. Serv., La. State Univ., Baton Rouge, La., Ext. Pub. 1180, April 1955, C. E. Severance and K. A. Koch.

"Humphreys County Soils," Agr. Exp. Sta., Miss. State College, State College, Miss., Bul. 532, Oct. 1955, C. Powell.

"Soil and Water Conservation Research in Puerto Rico, 1938 to 1947," Agr. Exp. Sta., Univ. of P. R., Rio Piedras, P. R., Bul. 124, May 1955, R. M. Smith and F. Abruna.

"Water, the Yearbook of Agriculture, 1955," USDA, Wash., D. C.

"Soil Survey, Montour and Northumberland Counties, Pennsylvania," Series 1942, No. 11, USDA, Wash., D. C.

Crops

"Growing Sweet Corn in Arizona," Agr. Exp. Sta., Univ. of Ariz., Tucson, Ariz., Bul. 264, July 1955, W. D. Pew and L. Hopkins.

"Forage Production on Arizona Ranges, IV. Coconino, Navajo, Apache Counties, a Study in Range Condition," Agr. Exp. Sta., Univ. of Ariz., Tucson, Ariz., Bul. 266, Oct. 1955, R. R. Humphrey.

"Range Resources of the South," Agr. Exp. Sta., Univ. of Ga., Athens, Ga., Bul. N. S. 9, Sept. 1955, R. E. Williams, J. T. Cassady, L. W. Halls, and E. J. Woolfolk.

"Clark Soybeans for Indiana," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind., Sta. Bul. 626, May 1955, A. H. Probst.

"Seventeenth Biennial Report of the Di-

rector, for the Biennium July 1, 1952 to June 30, 1954," Agr. Exp. Sta., Kans. State College, Manhattan, Kans., July 1955.

"Growing Wheat in Kansas," Agr. Exp. Sta., Kans. State College, Manhattan, Kans., Bul. 370, Aug. 1955, H. H. Laude, J. A. Hobbs, F. W. Smith, E. G. Heybe, A. L. Clapp, and J. W. Zahnley.

"Growing Sorghums in Kansas," Agr. Exp. Sta., Kans. State College, Manhattan, Kans., Cir. 319, May 1955, W. M. Ross and H. H. Laude.

"Fall Field Day Report of the Fort Hays Branch Station, Hays, Kansas, for 1954-55," Agr. Exp. Sta., Kans. State College, Manhattan, Kans., Cir. 330, Sept. 1955.

"1954 Preliminary Report of the Fruit and Truck Station, Hammond, Louisiana," Agr. Exp. Sta., La. State Univ., Baton Rouge, La.

"Annual Report of the Director of the Maine Extension Service for the Year Ending June 30, 1955," Agr. Ext. Serv., Univ. of Maine, Orono, Maine, Bul. 446, Nov. 1955.

"Russet Burbank Potatoes on Trial in Maine, 1954 Progress Report," Agr. Exp. Sta., Univ. of Maine, Orono, Maine, Mimeo. Rpt. 55, Aug. 1955, A. L. Perry, P. N. Mosher, and S. L. Painter.

"Planting Sweet Potatoes and Treating Sprouts," Agr. Ext. Serv., Univ. of Md., College Park, Md., Ft. Sh. 24, Rev. May 1955, F. C. Stark, L. E. Scott, and W. F. Jeffers.

"Michigan Department of Agriculture, Sixteenth Biennial Report for the Fiscal Years Ending June 30, 1953, and June 30, 1954," State Dept. of Agr., Lansing, Mich.

"A Survey of Forest Tree Plantings in Missouri," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., Bul. 640, Jan. 1955, R. W. Dingle and P. W. Fletcher.

"Growing Good Crops of Oats in Missouri," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., Bul. 644, Feb. 1955, J. M. Poehlman.

"Missouri Hybrid Corn Yield Trials, 1954," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., Bul. 648, March 1955, M. S. Zuber and C. O. Grogan.

"Report of the Director of the New Hampshire Agricultural Experiment Station, July 1, 1953 to June 30, 1954," Agr. Exp. Sta., Univ. of N. H., Durham, N. H., Sta. Bul. 418, April 1955.

"Care of the Established Lawn," Agr. Ext. Serv., Univ. of N. H., Durham, N. H., Ext. Bul. 130, June 1955, L. Higgins.

"Tomatoes for New Hampshire," Agr. Ext. Serv., Univ. of N. H., Durham, N. H., Ext. Cir. 314, May 1955, J. R. Hepler.

"The Seventy-fifth Annual Report, 1953-1954," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J.

"Extra Pasture with Small Grains," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Lflt. 137, Aug. 1955, J. E. Baylor and M. A. Sprague.

"Garden Varieties for North Dakota," Agr. Ext. Serv., N. D. Agr. College, Fargo, N. D., Cir. A-1 Rev., Jan. 1955, H. Graves.

"Which Oats to Grow," Agr. Ext. Serv., N. D. Agr. College, Fargo, N. D., Cir. A-224, March 1955, T. E. Stoa, C. M. Swallers, and R. B. Widdifield.

"Mulch as a Management System for Grapes," Agr. Exp. Sta., Wooster, Ohio, Res. Cir. 28, Nov. 1955, J. M. Beattie.

"Vegetable Variety Trials . . . Summary Through 1954," Agr. Exp. Sta., Okla. A. & M. College, Stillwater, Okla., Bul. B-463, Oct. 1955, F. A. Romshe and H. B. Cordner.

"The Method of Foliar Diagnosis as Applied to Sugarcane," Agr. Exp. Sta., Univ. of P. R., Rio Piedras, P. R., Bul. 123, Feb. 1955, B. G. Capo, G. Samuels, P. Landrau, Jr., S. A. Alers, and A. Riera.

"A Progress Report, Agricultural Research at the Range Field Station, South Dakota State College, Experiment Station, Cottonwood, S. D.," Agr. Exp. Sta., S. D. State College, Brookings, S. D., Cir. 116, May 1955.

"Early Crystal 281, an Early, White Onion for the South," Agr. Exp. Sta., Tex. A. & M. College, College Station, Tex., L-260, Sept. 1955.

"Report on the Agricultural Experiment Stations, 1954 with Special Emphasis on Food Science, Technology, and Marketing," Agr. Res. Serv., USDA, Wash., D. C., ARS-23-1, April 1955, R. W. Trullinger.

Economics

"Walnut Management Study, Santa Clara County, 1950 Thru 1954, Fifth Annual Report," Agr. Exp. Sta., Univ. of Calif., Berkeley, Calif., June 1955.

"Indexes of Volume of Agricultural Commodities Produced in Florida, 1910-1954," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Cir. S-88, Sept. 1955, A. H. Spurlock.

"Florida Truck Crop Competition, Inter-State and Foreign," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Agr. Econ. Series No. 55-2, Sup. to Bul. 224, Oct. 1955, C. V. Noble, M. A. Brooker, and D. L. Brooke.

"1954 Statistics of Hawaiian Agriculture," Agr. Exp. Sta., Univ. of Hawaii, Honolulu, Hawaii, Agr. Econ. Rpt. 24, May 1955, S. M. Doue.

"Economics of Forage Evaluation," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind., Sta. Bul. 623, April 1955, G. L. Johnson and L. S. Hardin.

"Economic Effects of Cropping and Livestock Systems on a rolling Central Indiana Farm," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind., Sta. Bul. 625, May 1955, M. R. Janssen and L. S. Robertson.

"The Potato Farm Business in Aroostook County, Maine, 1949-1950," Agr. Exp. Sta., Univ. of Maine, Orono, Maine, Bul. 541, July 1955, W. E. Schrumpf.

"Farm Practice Adjustments in Aroostook

County, Maine, 1948-1952," Agr. Exp. Sta., Univ. of Maine, Orono, Maine, Mimeo. Rpt. 48, Dec. 1954, W. E. Schrumpf.

"Long Range Financial Planning by Local Farmers Cooperatives," Agr. Exp. Sta., Mich. State College, East Lansing, Mich., Spec. Bul. 398, May 1955, V. L. Sorenson.

"How Price Supports Affected the Dry Bean Industry in Michigan," Agr. Exp. Sta., Mich. State College, East Lansing, Mich., Spec. Bul. 399, Sept. 1955, D. E. Hathaway.

"Industrialization and a Market for Food Products in the Kosciusko Trade Area," Agr. Exp. Sta., Miss. State College, State College, Miss., Bul. 534, Aug. 1955, D. Dickins, L. D. Welch, and W. E. Christian.

"Agricultural Atlas of Missouri," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., Bul. 645, Feb. 1955, J. E. Collier.

"Economics of Cropping Systems in the Cornbelt," Agr. Exp. Sta., Univ. of Nebr., Lincoln, Nebr., Bul. 429, N. Cen. Reg. Pub. 57, April 1955, W. D. Buddemeier, E. O. Heady, M. R. Janssen, H. R. Jensen, and H. W. Ottoson.

"Dryland Farm Organization in the Proposed Baldhill Area Irrigation Unit in North Dakota," Agr. Exp. Sta., N. D. Agr. College, Fargo, N. D., Agr. Econ. Rpt. No. 9, Jan. 1955, L. W. Schaffner.

"Fifty Years of South Dakota Agriculture," Agr. Exp. Sta., S. D. State College, College Station, S. D., Agr. Econ. Pamph. 56, Nov. 1954, R. F. Pongra and G. Lundy.

"Problems in Marketing South Dakota Grain," Agr. Exp. Sta., S. D. State College, College Station, S. D., Agr. Econ. Pamph. 62, June 1955, R. D. Tompkin and R. R. Newberg.

"Marketing Cut-flowers and Pot-plants for Home Use," Agr. Exp. Sta., Tex. A. & M. College, College Station, Tex., Misc. Pub. 138, Oct. 1955, A. F. Dewerth and H. B. Sorensen.

"Guide to Agriculture, U. S. A.," USDA, Wash., D. C., Agr. Inf. Bul. 30, Rev. Sept. 1955, A. F. Raper and M. J. Raper, Rev. by C. Senf.

"Agricultural Outlook Charts, 1956," USDA, Wash., D. C., Nov. 1955.

A Successful Corn Crop on the Same Land . . .

(*From page* 14)

precision soil testing so that the enterprise will be profitable from the farm standpoint.

The old Morrow Plots at Urbana have given a 25-bu. long-time average for corn grown continuously on the same land without soil treatment. This low yield is compared to a 56-bu. average obtained in a corn, oats, clover rotation also without other soil treatment. Based on these facts and under this system of operation, continuous corn growing might be classed as a failure. Recently fertilizers were added to a part of this continuous corn land and in 1955 the yield was 86 bu. on the fertilized land compared to 36 bu. an acre without fertilizers. The 36-bu. yield on the untreated continuous corn land was far above that of former years. Going through results of past years, Professor L. B. Miller points out that high yields on this land have been the rule following a previous dry season. Since 1954 was a very dry season he seems to have the correct explanation for the unusually high yield on the untreated land. The fertilizers for one year consisted of 200 lbs. of nitrogen, 150 lbs. P_2O_5, 100 lbs. K_2O and 5 tons of finely ground limestone. Since 1955 was the first year of the test the amounts of fertilizers added in the future may be adjusted to the actual needs for maximum yields. This is additional evidence that a successful corn crop on the same land year after year is a possibility.

It is evident that continuous corn in time does cause a considerable decline in soil organic matter which in turn destroys the tilth of the soil. Turning again to the Morrow Plots, the continuous corn land in 1953 was found to contain 24 tons an acre of organic matter in the topsoil. The land which had the corn, oats, clover rotation was found to contain 40 tons an acre. There were 49 tons found in the topsoil where manure had been added to maintain the supply in the legume rotation. These results indicate that continuous corn had cut in half the total soil organic matter in the topsoil. This is assuming that the legume rotation and added manure maintained the soil organic matter near that of the original virgin prairie land.

Fig. 3. A good corn crop and an excellent stand of alfalfa were obtained with wide corn rows on the University South Farm at Urbana (September 1955). The 60-inch row with close planting in the row has been found to yield as much grain as the conventional 40-inch row. The 80-inch row has given lower yields of corn but better legume stands and growth. An Indiana farmer says he is willing to sacrifice a little in corn yield in order to get the desired alfalfa stand so quickly.

There has recently come into use wide-row corn planting. The increased space is used for seeding and subsequent growth of legumes and grasses between the corn rows. This growth of legumes and grasses between the rows may be used in continuous corn as a means of keeping up the supply of organic matter, improving the tilth of the soil, and preventing serious erosion. The wide-row legume-grass planting has been developed in considerable detail at Funk's Research Acres near Bloomington, Illinois. In addition, experiment stations and farmers throughout the Midwest are making use of it. This plan offers numerous possibilities both in continuous corn and in rotations where legumes are a highly desirable part of the farm operation.

Establishing and Maintaining Alfalfa

(*From page* 12)

Chemical analyses show that grasses are heavier feeders of potash than alfalfa, thus more potash will generally be needed for alfalfa-grass than for alfalfa grown in pure stands. The experiment shows that the alfalfa stands are maintained in orchard grass mixtures provided 100 pounds or more of K_2O are applied annually per acre.

Alfalfa-orchard grass mixtures are very heavy feeders of potash; the first hay cut often removes 75 to 100 pounds of K_2O per acre. Experiments are under way on different soils in Virginia to see how the time of applying K_2O influences the yield and alfalfa-grass balance. When alfalfa-orchard grass mixtures were treated with 100 or 200 pounds of K_2O per acre in late winter as compared with similar amounts of potash after the first hay harvest, the yields were not changed in experiments at Blacksburg, Fig. 3. When 100 pounds of potash were applied in late winter and again after the first hay cut, the yield was 3.22 tons of hay as compared with 3.56 tons of hay per acre when 200 pounds of K_2O were applied

in one application in late winter. The low yield from the split application of K_2O is attributed to a lack of good utilization of the second split application because of dry summer weather. The heavy grass yield in the first cut apparently helped to create a shortage of potash which reduced the yield of the second harvest.

The potassium responses from an experiment carried on with Robert Sears of Southside Research Station on a Cecil soil at Charlotte Court House were quite different from those mentioned above, Fig. 4. When a total of 100 pounds of K_2O per acre was applied, a late winter application of potash produced 3.22 tons as compared with 3.82 tons when the potash was applied after the first hay cut. An application of 200 pounds of K_2O made in late winter produced 3.81 tons of hay as compared with 4.30 tons of hay per acre when all of the potash was applied after the first hay cut. A quarter of a ton more hay was produced when the potash application was split (one half each in late winter and after the second hay cut) as compared to the yield when all of the potash was applied in late winter. When moisture during the entire growing season is favorable, it may be predicted that 200 pounds of K_2O applied in early spring will produce less hay than applying the potash after the first hay cut or splitting the application into a spring and early summer application.

Orchard grass and most of the grasses of Northern origin produce one heavy mass of seed heads and stemmy growth in spring. The first harvest of such grasses or grass-alfalfa mixtures produces high yields which remove large amounts of potash because of the high tonnage, and also because of the high K_2O content of the grass component. It should be stressed that orchard or similar grasses compete aggressively for potash because these grasses start faster in the spring since they grow at lower air and soil temperatures than alfalfa. Orchard grass and other grasses are not aggressive toward alfalfa during the summer months because the drier soil and higher temperature conditions limit the growth of the grasses more than alfalfa. Grass growth is also shorter than alfalfa during the summer, hence it does not shade alfalfa. When alfalfa is adequately fertilized on adapted soils it competes aggressively toward grasses in the summer months. The application of some of the potash fertilizers after the first hay cut will help make alfalfa more competitive toward the grasses in the aftermath growths.

In an experiment at Blacksburg, K_2O was supplied in an adequate and constant amount, but phosphorus was varied, Fig. 5. The phosphorus fertilizer was applied in one application in late winter. The following yields were obtained for different amounts of P_2O_5 fertilizer: No P_2O_5—2.76 tons; 50 pounds of P_2O_5—3.20 tons; 100 pounds of P_2O_5—3.27 tons; and 200 pounds of P_2O_5 per acre annually produced 3.46 tons of hay per acre. Experiments in other locations show variable responses to P_2O_5, the yield increase being somewhat higher than for the Blacksburg experiment. In general, yield increases have occurred as phosphorus applications were increased up to 200 pounds of P_2O_5 per acre, but annual applications of P_2O_5 higher than 50 to 100 pounds per acre generally cannot be justified.

The use of grasses with alfalfa has not caused a phosphorus shortage as it has for potassium, since neither grasses nor legumes absorb and remove large amounts of phosphorus. It is interesting to note from the viewpoint of phosphorus content that grasses are as good in feeding value as legumes.

Cutting and Grazing Management

Alfalfa can be used for silage, hay, and pasture, but proper grazing and cutting management must be practiced if alfalfa is to be productive and long-lived. An experiment was carried on at Blacksburg to study yields and stands of alfalfa as related to cutting practices. The soil was limed adequately and fer-

tilized annually with phosphorus, potassium, and borax. An alfalfa-orchard grass mixture was cut in spring for silage when alfalfa was in the bud stage and orchard grass had started to head, and then cut three times for hay when alfalfa was in the tenth bloom stage. This silage and three-hay-cut treatment produced an average annual yield of 4.82 tons during a three-year period. When the alfalfa-grass mixture was cut three times annually (alfalfa in a full bloom stage) the yield averaged 4.77 tons of hay per acre. The yield of the same mixture amounted to 4.38 tons per acre when it was cut early for silage in spring, followed by one hay cut in the tenth bloom stage and three subsequent grazing cuts when the alfalfa was about 12 to 15 inches high. The average yield of the plots harvested as six grazing cuts annually, alfalfa about 12 to 15 inches high, was only 2.08 tons of hay per acre for the three-year period, Fig. 6. The hay of alfalfa cut three times each season was stemmy and low in protein and digestibility, when compared with hay quality from four yearly cuttings.

In these experiments, the alfalfa-orchard grass mixture cut six times per year is now made up of less than 10% alfalfa and more than 90% of orchard grass, Fig. 7. On the other hand, on the plots that were cut early for silage followed by three hay cuts, alfalfa makes up more than 75% and orchard grass makes up less than 25% of the mixture. Our experiments show that the first growth of orchard grass in the spring is competitive toward alfalfa. We believe that the early cutting of this mixture, when alfalfa is in the bud stage, is desirable because this cutting practice helps to eliminate the tall competitive growth of orchard grass. The aftermath growth of orchard grass, because of its leafy shorter growth and slower growth at higher temperatures, and lack of drought resistance, competes little toward alfalfa.

Alfalfa-grass mixtures can be pastured, if short grazing periods are followed by long rest periods. The grazing period for a given field should not last more than a week, after which the alfalfa should be permitted to recover to a bud or an early bloom stage. Grazing should be manipulated by using electric fences so as to cut big fields into small fields where they will be grazed down quickly. Cattle should not be permitted to graze alfalfa earlier than the bud growth stage. Two successive growths may be grazed during the bud stage, provided the next growth is permitted to bloom. If grazing is delayed to the 1/10 or ½ bloom stage, much feed is wasted as cattle refuse to eat the basal stemmy growth. In fields where there is a heavy growth in late fall, grazing the top growth after frost has not injured the winter survival and crop yields the following year. We have not encountered bloat when grazing alfalfa-grass mixtures.

Disease and Insect Control

It is not practical, at present, to spray for disease control. The use of adapted varieties is the best way to limit the bad effects of troublesome diseases.

Several insect pests seriously injure alfalfa stands and hay quality. Spittle bugs, which can be controlled by insecticides, are often troublesome pests that cause reduced yields. Alfalfa leaf weevils are extremely harmful pests to the first and second alfalfa hay cuttings in parts of Virginia and Maryland. Early cutting of the first hay crop followed by spraying has given quite good control. Any of several insecticides will control potato leaf hoppers, which often injure the third or the second and third crops of alfalfa.

Alfalfa Not a Panacea

The employment of alfalfa will not cure nor solve all of the farmers' forage problems, but this crop should be used more extensively in the Eastern United States. Alfalfa has certain distinct disadvantages: (1) It cannot be utilized as early in the spring nor as late in the

fall as certain other grasses and legumes; (2) the grazing and cutting management of alfalfa is more critical than for other legumes; (3) alfalfa is not adapted to soils with poor drainage; (4) alfalfa does not have a spreading habit and each plant is dependent on its initial root, hence root injuries cause stands to become poor.

The farmers that use several grass-legume mixtures are more apt to have a large supply of pasturage, hay, and silage, all of which are necessary for a reliable 12-months forage program.

Use of Radioactive Potassium in Soil-plant Studies

(*From page* 20)

tive nature of all of them indicates some effect of weight of plant on subsequent concentration within the plant, and this effect is opposite that of dilution. Dilution means a lowered content of a nutrient because of a plant or plant part merely being larger. A further evaluation of the effect of plant size was obtained by calculating the ratios of uptake for the high nitrogen plants to the low nitrogen plants. For the two nitrogen levels the ratios for concentrations of fertilizer potassium in the leaves were narrower than those for the weight of any of the plant parts. This indicates a modification by nitrogen of the enhancing effect of a large plant on the potassium uptake. This merely could be that more potassium was available per unit of plant to the small plant. Nitrogen effects on potassium uptake have been previously described (9).

TABLE IV.—VERTICLE DISTRIBUTION OF APPLIED K IN THE LEAVES OF 5-MONTH-OLD CITRUS SEEDLINGS, 12 AND 84 HOURS AFTER A SOIL APPLICATION OF $K_2{}^{42}SO_4$.

Leaf position*	K increase after 12 hours	K increase after 84 hours
	me. K/1000 gram dry plant material	
Sweet Orange—16 inches tall		
1	7.92	4.34
2	0.86	4.11
3	0.89	4.25
4	0.62	5.44
5	1.76	4.85
Sour Orange—16 inches tall		
1	1.90	4.35
2	0.74	3.29
3	0.49	3.02
4	0.43	2.67
5	0.52	2.20
Trifoliate Orange—28 inches tall		
1	0.65	1.28
2	0.98	0.47
3	1.48	0.96
4	0.44	0.96
5	1.14	1.42

* The leaves were sampled from five equal zones beginning with No. 1 at the base and No. 5 at the apex.

It is of interest to note that there was a positive but not significant correlation (+0.319) between the concentration of fertilizer potassium in the plants at 15 hours compared with that at 71 hours. This is indicative of difficulty in getting fertilizers uniformly distributed in a short time period when applied to pots. For all species, except for one rough lemon, there was an increase in uptake between sampling periods (15 hours and 71 hours). There was also a narrower ratio for high to low nitrogen on the potassium uptake at 71 hours than at 15 hours. In several other studies this tendency to "catch up" was observed.

Test 3. "Gradient" of fertilizer K distribution in citrus soon after application to the soil.

This study was made to determine the distribution of recently absorbed K^{42} in different leaves of a plant. Each pot contained one each of seedlings of sweet orange, sour orange, and trifoliate orange which had been potted together in soil on March 10, 1954. The

plants had received applications of nitrogen periodically and at the time of K^{42} studies the trifoliate was about 28 inches tall while the sour and sweet oranges were about 16 inches tall.

Three pots of the combinations were treated. The plants were sampled by establishing five equal zones along the length of each plant and taking leaves from each zone. Samples were taken 12 and 48 hours after treatment with K_2SO_4.

The pattern of content of labeled potassium in different leaves, as shown in Table IV, was very different at 84 hours than at 12 hours after application. At the first sampling the basal leaves tended to show the highest amounts for sweet and sour orange. With trifoliate the center leaf sections had the highest accumulation. By the time of the second sampling, the amount in the leaves had increased but there were little differences between top and bottom leaves.

Test 4. Absorption of potassium by avocado seedlings.

Seeds of Hass and Mexicola avocado, as representatives of the Guatemalan and Mexican races, respectively, of *Persea americana,* were split into two pieces each (8) and the pieces were germinated in vermiculite. The purpose of the split-seed technique was to make comparisons with genetically identical material. After three weeks (February 23, 1954) the plant growing from one half of each seed was transplanted to a noncalcareous soil in an eight-inch clay pot and the plant from the other half of the same seed to the same soil to which 5% $CaCO_3$ by weight had been mixed. The only fertilization the plants received was two applications of nitrogen in the form of NH_4NO_3 at the rate of 0.3 g. nitrogen per pot during the seven months' growing period.

Fifteen hours after the treatment was started, samples for analysis to determine uptake of K were taken by punching one 1-cm disc from each of 15 different leaves on each plant. The discs were placed immediately into a crucible and ashed at low heat (400-500°F.) for 15 minutes. The ash was then transferred to 10-ml. stainless steel counting cups as previously described.

For a dry-weight determination, the same number of discs taken from the same leaves were dried at 70°F. and weighed. Following the radio-analysis, the plants were harvested and sectioned into leaves, stems, and roots, and the dry weight of each plant part was determined.

The data on influence of lime on the growth of avocado and also on the uptake of potassium applied to the soil are in Table V. The presence of lime reduced significantly the growth of leaves and weight of stems in the Mexicola and also for leaves in the Hass. It is to be remembered that of each pair of plants grown, one in limed and one in nonlimed soil were each from the same seed. The leaf content of labeled potassium, as measured 15 hours after application, was significantly influenced by lime in the soil. The effect was one of a depressed K^{42} content in the case of Hass and enhanced content with the Mexicola. This is indeed interesting but as yet neither its cause nor significance is known.

These data on potassium uptake by plants growing in soil should be viewed primarily as indicating the feasibility of using this isotope in soil-plant studies. It is felt that the results indicate that experiments which could use K^{42} in answering many basic soil-plant problems might be established.

Summary of Precautions Necessary and Suggestions in Using K^{42} in Soil-plant Studies

Those problems encountered in the studies are briefly listed below:

a. A decay correction must be made for each 10 minutes of lapsed time in the studies.

b. Since the studies must be of short-time duration, equal distribution in the soil mass is extremely critical. Other-

TABLE V.—GROWTH OF AVOCADO SEEDLINGS AND LEAF CONTENT OF APPLIED POTASSIUM 15 HOURS AFTER SOIL APPLICATION OF $K_2{}^{42}SO_4$ AS INFLUENCED BY LIME.[a]

Soil treatment	Dry Weight			Leaf content[b] of applied potassium
	Leaves gram	Stems gram	Roots gram	me. K / 1000 gram dry plant material
	Mexicola seedlings[c]			
Nonlimed.....	9.6 ± 2.5[d]	4.1 ± 1.2	7.8 ± 2.0	0.160 ± 0.074
Limed.....	5.4 ± 1.1**	2.3 ± 1.0*	6.1 ± 1.4	0.523 ± 0.258
	Hass seedlings[c]			
Nonlimed.....	12.7 ± 2.9	9.4 ± 1.8	12.4 ± 3.3	3.144 ± 1.730
Limed.....	8.6 ± 3.0*	6.6 ± 3.1	9.2 ± 2.8	1.419 ± 0.326

[a] Each value based on seven pairs of plants grown by the split seed technique (8).
[b] Of dry leaf tissue basis.
[c] Mexicola of Mexican race and Hass of Guatemalan race.
[d] Standard error.
* F test significant at 0.05% level when comparing limed vs. nonlimed plants.
** F test significant at 0.01% level when comparing limed vs. nonlimed plants.

wise, tremendous variability occurs in the amount of isotope in the plant samples.

c. Extremely low application rates of K^{42} are not possible because of soil chemical interactions that reduce the uptake of applied potassium; also, large application rates take the nature of culture solutions. It is extremely difficult to label the cations already held on the clay complex without removing them completely and adding new.

d. There are differential absorption rates for the first few hours after application compared with two or three days after. Treatments giving low initial uptake tend to catch up. In our studies we spent too much time analyzing samples after 12 hours' treatment and not sufficient after a few days. The physical capacity of a laboratory staff is very important here because of the overtime work involved.

e. Two kinds of isotopic exchange are important. We did not observe the need for evaluating each until the isotope had decayed too much. The first of these is concerned with absorption. Hevesy (2) has demonstrated a loss of one phosphorus atom from a root for six atoms absorbed by a root. This implies that the number of labeled atoms in the plant may not be an accurate measure of absorption. We found in our studies that the ratio for calcium ions was also about one to six (6). Depending on the length of time of the study, the amount of radioisotopic calcium in a plant would represent absorption within 16 per cent error, but usually much less. Because of its highly mobile nature, potassium may result in larger errors. The second method of isotopic exchange occurs within the plant. It has been demonstrated that this creates a problem in nitrogen studies. After absorption by a root, the radioactive potassium mixes with potassium already in the root and a mixture of this is translocated to the leaves. Leaf analysis then cannot be used as an exact measure of absorption for a very soluble element like potassium and also as an accurate measurement of translocation for the same reason. This is especially true for very short-time studies. This latter phenomenon does not invalidate analysis of a complete plant. Another form of isotopic exchange—that between the fertilizer K and the

soil K—will have a bearing on the results, especially if it is more pronounced under one set of conditions than another. An example would be in the soils maintained at different temperatures.

f. The tolerance of the plants to the amount of radiation was not investigated. The K^{42} was applied at the concentration of approximately 5-microcurie initial dosage per me. potassium and 5 me. were used per plant. These levels were about one tenth that considered toxic for some other elements (1).

g. There is some radiation hazard to personnel with the initial quantity of K^{42}. Facilities and equipment should be available so that the initial quantity can be opened, diluted, and transferred in as few minutes as possible and behind shielding.

h. Counting equipment can easily be a limiting factor in this kind of study. The hundreds of samples that had to be counted in the space of four days required that our scaler operate continuously 24 hours a day. Studies like this indicate the need for automatic sample changing equipment, a standby scaler, and also a scintillation well-counter. Since the initial use of K^{42}, our laboratory has been equipped with these instruments. With the scintillation well-counter, gamma-emitting isotopes can be counted with relatively high efficiencies and with a minimum of sample preparation. Since only gamma rays are counted, fresh green or dry tissue, solutions, or soil can be counted with corrections for self absorption unnecessary.

i. The assumption was made that K^{39} and K^{42} are physiological equivalents in terms of absorption and translocation. Further experiments may reveal this unjustified.

Summary

A unit of radiopotassium (K^{42}) was obtained from the Oak Ridge National Laboratory. Part of this material was used to establish four simple soil-plant experiments with citrus and avocado. Sufficient experience was obtained to help properly plan further experiments using this or other short-life isotopes in soil-plant studies. The four experiments conducted gave information on the distribution of fertilizer potassium in leaves of different sections of citrus species and on the influences on potassium uptake of temperature of soil, excess lime in the soil, species of rootstock, size of root system, and nitrogen deficiency. The data are not final answers on these questions, but do indicate possibilities for studies of this kind.

Specifically the influences were as follows:

a. Within a few hours fertilizer potassium was quite uniformly distributed throughout all the leaves of the plants studied.

b. A root temperature of 75°F. relative to 65°F. stimulated the absorption of potassium by different citrus rootstocks and a temperature of 88°F. decreased it. Some implications of this were described.

c. The influence of added excess lime in the soil on the potassium uptake by citrus was a function of plant size. Differences existed because of an interaction of lime and rootstock on plant size. In avocado, however, the presence of lime stimulated potassium absorption for one variety and decreased it for another.

d. In the short-time study citrus rootstocks had only a slight effect on potassium absorption that could not be attributed to plant size.

e. Nitrogen deficiency resulted in a decreased potassium absorption and this could not be explained entirely on the basis of plant size.

Literature Cited

1. Hendricks, S. B., and Dean, L. A. 1952. Radioisotopes in soils research and plant nutrition. Ann. Rev. Nuclear Sci. 1: 597-610.

2. Hevesy, G. 1945. Interaction between the phosphorus atoms of the wheat seedlings and the nutrient solution. Archiv. for Botanik 33: 1-16.

3. Hoagland, D. R., and Broyer, T. C. 1942. Accumulation of salt and permeability in plant cells. Jour. Gen. Physiol. 25: 865-880.

4. Jenny, H., Overstreet, R., and Ayers, A. D. 1939. Contact depletion of barley roots as revealed by radioactive indicators. Soil Sci. 48: 9-24.

5. Sauchelli, V. 1948. Radioisotopes: an indispensable aid to agricultural research. Better Crops With Plant Food 32: No. 3.

6. Smith, R. L. 1955. Factors influencing the absorption and translocation of calcium and potassium by citrus and some other plant species. Ph.D. thesis. University of California, Los Angeles.

7. Stout, P. R., and Hoagland, D. R. 1939. Upward and lateral movement of salts in certain plants as indicated by radioactive isotopes of potassium, sodium, and phosphorus absorbed by roots. Amer. Jour. Bot. 26: 320-324.

8. Traub, H. P., and Auchter, E. C. 1933. Sprouting and grafting fractional parts of avocado embryos with attached cotyledonous material. Science 78: 389-390.

9. Welch, H. V., Jr., Wallace, A., and Mueller, R. T. 1954. Influence of factorially combined levels of cations and nitrate ions absorbed on ion-exchange resins on the nutrient absorption by plants. Soil Sci. Soc. Amer. Proc. 18: 137-140.

Lawn Seed Is Not Fertilizer

"WHY do some people try to fertilize their lawns with grass seed?" a witty gardener recently asked Victor H. Ries, Ohio State University Extension Floriculturist. Ries admitted he couldn't explain it because he has preached that commercial fertilizer is better than grass seed to thicken established lawns.

Ries advises March applications of 2 to 4 pounds per 100 square feet of a 4-12-8, 5-10-5, 5-10-10, 4-12-4, 6-10-4 or 10-6-4 fertilizer.

Farmers who have 10-10-10 or 12-12-12 fertilizer may use this on lawns, but they should use only 1 to 2 pounds per 100 square feet. Larger amounts of these grades of fertilizer may cause "burning" on lawns.

Fertilizing lawns and mowing no closer than 1½ to 2 inches helps control weeds because the grass stand becomes denser and outgrows weeds.

Tomatoes Are Greedy

TOMATOES are rank feeders, and a good crop will remove large amounts of plant food from the soil. For that reason, it pays to fertilize them well for maximum yields, says Professor Eugene Brasher, Head of the Horticulture Department at the University of Delaware.

Brasher recommends an 8-16-16 or 5-10-10 fertilizer for the heavier soils and 5-10-15 for the lighter or sandy soils. About three fourths of the fertilizer should be broadcast and plowed under as the land is fitted for tomatoes. The remaining one fourth should be applied at planting time.

A 10-ton-to-the-acre crop, not a particularly heavy yield of tomatoes, removes 100 pounds of nitrogen, 35 pounds of phosphorus, and 175 pounds of potash in the fruit alone, he explains.

"Yields of 20 tons of marketable tomatoes to the acre are frequently obtained," Brasher adds.

While the amount of phosphorus removed by the tomato crop is relatively small, at least four times that amount should be applied because of the rapid "fixation" of phosphorus to unavailable forms in the soil. On the other hand, if large amounts of fertilizer high in phosphorus have been applied for a number of years, a lower phosphorus ratio will give as good crop yields with less cost.

Certain Practices Are Important . . .

(*From page* 26)

generally contain enough phosphorus and potassium to meet the needs of pecan trees. They need some nitrogen, however. Usually about ¼ to ½ pound of ammonium nitrate or its equivalent per year of tree age (for example, 5 to 10 pounds per 20-year-old tree), applied each spring, is enough. When a good growth of winter legumes is turned under, the amount of nitrogen needed may be less. Soil tests may show that phosphorus and potassium have become partially depleted in some delta areas. In such cases, apply enough potash and phosphorus in the fall for good cover crop growth.

Culture, Cover Crops, and Pasturing

Young pecan trees must be cultivated in the summer. Do not let grass and weeds grow within 4 or 5 feet of the trunks of newly planted trees. For the first year or two after they are set out, hoe around them as often as needed to keep the grass and weeds down. Keep the ground cultivated from the trunks to 4 or 5 feet beyond the spread of the branches until the trees are old enough to bear.

You may plant intercrops in the remaining space between the rows. As the trees increase in size you will need to cut down the space for intercrops a little each year until you can no longer grow them profitably. Cotton or truck crops are all right to use. After the trees have started to bear, do not grow summer legumes, such as soybeans or field peas. They attract stink bugs and other plant bugs that sting the developing nuts and cause kernel spot and black pit. Keep the intercrops cultivated and use enough fertilizer for both them and the pecan trees.

Two systems of culture may be used in bearing orchards instead of intercrops, and after the intercrops must be stopped:

1. Winter cover crops and summer pasture,

2. Winter cover crops and summer cultivation.

Winter cover crops of legumes are a "must" in all bearing commercial pecan orchards.

If properly done, pasturing Bermuda grass and clover sod is the most economical way to manage pecan orchards. It costs less and takes less work than to cultivate during the summer and to replant the winter cover crops each fall, and it provides some extra income from the livestock. But you must do it so as to take care of the pecan trees first, or you will be out of the pecan business and in the livestock business alone in a short time.

In the first place, use enough fertilizer, especially nitrogen, for both the pecan trees and the pasture. In the second place, keep enough animals in the orchard to graze the pasture well. If the animals must be removed for any reason, then keep the pasture mowed. If Bermuda and other grasses are allowed to grow very much they will take too much moisture and plant food from the trees.

Always use a leguminous winter cover crop along with a pasture program. A reseeding variety of crimson clover is especially good. When you first start this, prepare the seedbed well, apply phosphate and potash and inoculate the clover seed. Rye, ryegrass, or oats may be planted with the legumes. Obtain the advice of your county agricultural agent in deciding what cover crops to plant for your soil and climate, and for the seeding rates. Winter cover crops may be pastured to a limited extent. Let the clover become well established before putting livestock in the orchard.

Do not overgraze the winter cover crop and take the animals out of the orchard in time to let the clover blossom and form seed. After the seed are

ripe, let the clover die down or knock it down with a disk, but do not disk it deeply into the soil. Each fall after that, apply phosphate and potash fertilizers and then disk the soil 3 or 4 inches deep before the clover seed start to sprout. Take the livestock out of the orchard before the fall disking and do not put it back until the clover is well started. Winter cover crops and summer cultivation have been used in pecan orchards for many years.

Crimson clover, white or white Dutch clover, hairy and common vetch are winter legumes that can be grown on most soils in Mississippi. These vetches are susceptible to some soil-borne diseases and should not be grown year after year on the same land. Austrian winter peas will grow in most parts of the State, but are so susceptible to several diseases that they should not be grown on the same land more than 1 year in 4 or 5. Giant southern bur clover, blue lupine, and wild winter peas may be used for special situations. When a legume is planted where it has not been grown for several years, inoculate the seed for the first year or two until the crop has become established.

Plant winter cover crops as soon after September 15 as there is enough moisture for seed germination and growth. Plant them not later than the middle of October in the northern part of the pecan belt or the first of November in the Gulf Coast areas.

Disk the cover crop lightly into the surface soil when it reaches greatest growth in the spring. Then disk lightly every 3 to 5 weeks to keep down grass and weeds until time to apply fertilizer and plant a new cover crop in the fall. A disk tiller, also called a rotary plow and a wheatland plow, used instead of a disk after the last of June will cover the small dropped nuts containing larvae of the pecan shuck worm and will provide partial control of this insect.

Rails and the Ruralite

(*From page* 5)

author of the "Rural" columns in some of the Midwest newspapers. Many chapters in Illinois farm history are devoted to Dunlap's pioneer horticultural influence. The estate near Champaign is still in the Dunlap family and one of his descendants, Matt Dunlap, retired only two years ago as a wood technologist with the U. S. Forest Products Laboratory, Madison, Wisconsin.

Going back a moment to the original agricultural and colonization idea held by the road's bosses in the fifties, a reference note tells us that some of the extensive literature and advertising copy of that era which the road broadcast in printed form everywhere in the nation was prepared by Augustus Dickens, brother of the great English novelist, Charles Dickens. Not much is known about the rural qualifications of Mr. Dickens, but he surely knew how to get out posters and display ads that brought thousands of settlers to the land offices of the I. C.

Some examples of that early advertising for land buyers and agricultural settlement are preserved in books and historical files. Two or three of them came to hand lately, embellished with woodcuts and ornate headings. They took space in all kinds of periodicals but the particular prints I have before me are from that famous old prospectus of fashion and household arts, "Godey's Lady's Book."

"900,000 acres of the finest farm lands for sale in the Garden State of America by the Illinois Central Railroad Company. These lands all lie adjacent to the railway which extends from Dunleith down through the center of the State to Cairo, with a branch from Chicago to Centralia. These lands are located the whole 706 miles and in no instance at a greater distance than 15

miles from the track. . . . It is conceded that the best beef in America is that fattened on the prairies of Illinois. The cattle trade is immense. Fortunes have been made in this branch of the industry and the field is still open for like results. Old farmers from Ohio, Kentucky, and the densely settled parts of the older states are selling their more valuable farms and emigrating to these lands of richer soil and cheaper price, where the range for feeding is extensive, hay can be had for the gathering, and artesian water obtained at little expense."

It spoke of the growing hog industry and the raising of horses and mules for the Southern markets. The early ripening of fruit in southern Illinois was listed also, enabling the growers to get high prices for the first of the season's apples, plums, grapes, and berries, with the markets of Chicago, Cincinnati, and St. Louis being supplied from this region.

Only $6 to $12 per acre was the inducement offered, cash or credit. Lots of 40 acres and upward were offered, rated according to quality and nearness to stations. The cash deduction from the list prices of these lands was 10 per cent, so that a buyer who paid cash for 40 acres at $8 per acre had to plank down only $288. The terms then advertised were a quarter of the principal cash down, and the rest at one, two, and three years at 6 per cent.

IT had then been fully 10 years since the first lands were sold and by 1866 the land commissioner of the I. C. stated that during the period 1,555,000 acres had been transferred to 25,000 new settlers. The railway touched 49 counties and their rapid development was evident from the 350,000 enumerated by the census of 1850 to 1,127,000 population registered in 1865.

When the first state fair was held at Centralia, records show that the I. C. offered its roundhouse for the exhibits and hauled goods for the exhibits free. As the town was small, many of the visitors to the fair stayed in the cars in lieu of scant hotel accommodations. The I. C. had its share of "firsts" in agriculture. The first fruits and vegetables shipped under refrigeration, the first soil tests on an extensive scale, the first limestone dispensing train, the first soybean educational train, one of the first to feature "better bulls" on exhibit trains, first one to employ a creamery buttermaker to advance community dairy manufactures, and a pioneer demonstrator of boll weevil control methods. Of course, in many of those projects the road teamed up with the suitable colleges of agriculture operating in their territories. Before the days of the radio, the truck, and the auto, the college extension people were delighted at the cooperation thus provided by leading railroad land and farm departments. Their lessons were put on wheels and carried to remote places where the folks didn't travel much, at a time when county extension agents and vo-ag teachers were almost unheard of "luxuries."

DIGRESSING, I recall personal experience on one of those same early era demonstration trains. We called it the "stump pulling special," as its route lay in the cut-over country of northern Wisconsin and parts of northeastern Minnesota. The Soo Line, the Milwaukee Road, the Chicago & Northwestern, and the agricultural college and five manufacturers ran it. In those days it was a romantic sort of industrial circus. We had horsepower and one-man-power stump yankers and a lanky dynamite expert from Delaware to blow the stumps, gouge out the ditches, and shatter the big rocks. This was during the big boom for farm products as World War I thundered toward us. Our ultimate results may not have been so good, however, as many of the farms thus carved in the wake of the lumberjacks had sub-marginal conditions to meet after the "food for freedom" urge had ended.

Revitalizing run-down farms sounds

like good business sense for a provident railroad to undertake. In this case, we refer to low-producing farms that lie in areas where soil improvement and conservation methods may be expected to bring profits to the operators in reach of good markets. In this field, several roads have rendered top service. The I. C. began chemical soil testing away back in 1865. It set up its own soil analysis laboratory and sent mobile test units everywhere. More than 20,000 tests are made each season by the I. C. agents.

WE are told that soil conservation practices and changes in land use are often accomplished at the suggestion of the railroad's own agricultural agents. Rough, eroded lands not fit for row crops are put into grassland systems and planted with soil-conserving crops. On some extra steep slopes the planting of forest trees is encouraged to halt the gully washing and topsoil losses. Even some drainage work is done where it will pay best. A sound balance between maximum food and fiber production and soil fertility is upheld in correcting the situations on these critical farms adjacent to the road's trackage.

Some Northern dairymen after World War II were wont to bewail the fast expansion of the dairy industry into the central deep South. They made such a furore over government encouragement to soil conservation and better pastures that, as an observant farm writer of the period, it seemed advisable to visit some of the newer dairy developments down there. Almost every new cheese factory, creamery, and condensery straight from Cairo to New Orleans was visited with notebook and kodak.

The sum and substance of it was that the South was trying to diversify and get both feet out of the cotton patch. Moreover, all the milk volume at that time was largely used regionally. Manufactured dairy products and fluid milk production were just beginning

DO YOUR OWN SOIL TESTING WITH Simplex SOIL TESTERS

BIGGER YIELDS—GREATER PROFITS

Are yours if you test your soils the SIMPLEX way. SIMPLEX Soil Testing is a sure way for profits through productive soil. SIMPLEX Soil Testing gives you a far more accurate means of determining the fertility of soil than other methods.

COMPLETE KIT

All the reagents and apparatus necessary for a complete chemical diagnosis of the soil, including a detailed instruction book. The apparatus will last indefinitely. Refills of the reagents may be secured at any time.

$49.50 FOB Norwalk RR Exp.

JUNIOR KIT

All the reagents and materials necessary to make 100 to 300 tests for the following plant growth factors.
Nitrates • Phosphorus
Potassium • Calcium
Ammonium • Acidity
Plus tissue tests for Nitrates, Phosphorus and Potassium.

$33.50 FOB Norwalk RR Exp.

FARM KIT

100 tests for the following five elements.
Nitrates • Potassium
Phosphorus
Ammonium • Acidity
Plus tissue tests for Nitrates, Phosphorus and Potassium. This equipment is designed for the smaller grower.

$25.50 FOB Norwalk RR Exp.

Remember the SIMPLEX Soil Tester is not a toy. It is based on scientific methods devised at Michigan State College by Dr. Charles H. Spurway. You can't plant efficiently without the SIMPLEX Soil Tester.

WRITE THE EDWARDS LABORATORY
0000 SIMPSON AVE., NORWALK, OHIO

to supply the home market, let alone any alarming signs of competition on a big scale for the producers of Wisconsin, Iowa, and Minnesota.

We discovered that the I. C. had had such good results in Illinois with its educational and better dairy sire programs that the work was expanded into Kentucky, Tennessee, and part of Mississippi. First signs of this new era for the South were noted at the Memphis national dairy shows, partly tracing to the I. C. program under which the railroad made services of bred-for-production sires available to improve the quality of the dairy cattle. Not content with notably bettering the herds supplying these new home markets, the railroad later on, in 1944, promoted artificial insemination. Starting at Yorkville, Tennessee, the plan was extended to Kentucky, Tennessee, Mississippi, and Louisiana. Cows born of this artificial breeding not only enhanced the quantity and quality of the milk but they took a large slice of the blue ribbons for type in the stock shows of 1950-51.

WHILE they didn't start the youth movement among farm communities, centering in the 4-H clubs and Future Farmers of America, the I. C. eagerly "got aboard" the "unlimited" program in behalf of sound agriculture in the future. Its agents aided some of the first feeble local 4-H shows and contests before the sweep of this popular organization from coast to coast. The trips to the International Livestock Show and National Congress of Boys' and Girls' Club Work appealed to the I. C. officials. Nearly 1,200 winning 4-H leaders and members have gone to this event under the road's sponsorship. Besides, they tell us that at least two of the road's agricultural agents are former 4-H club boys. In a similar way they have helped vocational agriculture in high schools, through educational and financial aids to instructors and FFA chapters.

Forest products have always been a major source of freight revenues for the I. C. So they decided to try and do for timber cropping what they had achieved in agriculture. Today the road maintains the largest trained staff of foresters of any line in the nation. Other major roads also have seen the necessity of safeguarding forest resources and have done likewise. Mechanical tree planting was a problem, so the I. C. shop at McComb, Mississippi, devised a fast and accurate machine that has been adopted widely as fast as manufacturers can make them. Thousands of acres of raw stump land without any steady return have been planted to the proper species of trees with the use of this machine. So now the farm and forest agents employed by the I. C. belong to what is known as the "agricultural and forestry department." Its headquarters office is at 135 East Eleventh Place, Chicago 5, Illinois. Readers who want to know more fully what enterprising railroads can do may get a line on the subject at that address. Other good offices with backgrounds of agricultural education are these: Agricultural Development Department, Northern Pacific Railroad, 5th and Jackson Streets, St. Paul, Minnesota, and Supervisor of Agricultural Development, Union Pacific Railroad, Dodge Street, Omaha, Nebraska.

ALMOST regardless of where one resides these days, the nearest railway depots carry folders that will give one a key to the location of their respective agricultural development bureaus. If no comprehensive book has yet been written about the farm development efforts of the major railroads, this is a good time to prepare and publish one. It would include romance and tragedy, humor and stimulation. Not all the efforts were successful—with railways as with college experiments. But they are so typical of the whole spirit of America and represent such wholesome teamwork between agricultural allies that "rails and the ruralite" should be more generally recognized for what their cooperation has meant to national progress.

Naugatuck Agricultural Chemicals

product	application	advantages
Aramite miticide	controls mites on citrus and deciduous fruits, cotton, other row crops, ornamentals and vine crops. Also controls poultry mites.	non-hazardous, low cost per acre, highly compatible, harmless to natural predators.
Spergon® seed protectant	controls soil fungi and storage insects (with DDT) on most crop and vegetable seeds.	effective at economical dosages, safe on seed, easy to use, compatible with most other chemicals including legume inoculants, low cost.
Phygon®-XL fungicide	controls fungus diseases on fruit trees and row crops.	extremely low cost per acre, easy to apply, compatible, harmless to pollen and bees.
MH growth retardant and herbicide	inhibits grass growth; controls wild onions and quack grass; prevents tobacco suckering. Pre-harvest application prevents destructive storage sprouting of edible onions and potatoes.	extremely safe on plants; easy to apply; in wild onion control, one spray lasts up to 3 years.
Alanap® pre-emergence weed killer	pre-emergence weed-control for vine, row crops; asparagus and nursery stock. Available commercially for use on vine crops.	safe on recommended crops, relatively non-toxic, easy to apply, favorably priced.
Duraset*-20W flower and fruit-setting compound *U. S. PAT. 2,556,665	a fruit-setting chemical for lima beans, legumes, peppers and various tree fruits.	low dosage per acre, easily applied as a foliage spray.

US RUBBER

United States Rubber

Naugatuck Chemical Division

Naugatuck, Connecticut

FREE LOAN OF EDUCATIONAL FILMS

The American Potash Institute will be pleased to loan to educational organizations, agricultural advisory groups, responsible farm associations, and members of the fertilizer trade the motion pictures listed below. This service is free except for shipping charges.

FILMS (ALL 16 MM. AND IN COLOR)

The Plant Speaks Thru Deficiency Symptoms (Sound, running time 25 min. on 800-ft. reel.)

The Plant Speaks, Soil Tests Tell Us Why (Sound, running time 10 min. on 400-ft. reel.)

The plant Speaks Thru Tissue Tests (Sound, running time 14 min. on 400-ft. reel.)

The plant Speaks Thru Leaf Analysis (Sound, running time 18 min. on 800-ft. reel.)

Save That Soil (Sound, running time 28 min. on 1200-ft. reel.)

Borax From Desert to Farm (Sound, running time 25 min. on 1200-ft. reel.)

Potash Production in America (Sound, running time 25 min. on 800-ft. reel.)

In the Clover (Sound, running time 25 min. on 800-ft. reel.)

In Canada: The Plant Speaks Thru Deficiency Symptoms
The Plant Speaks, Soil Tests Tell Us Why
The Plant Speaks Thru Tissue Tests
The Plant Speaks Thru Leaf Analysis
Borax From Desert to Farm
Potash Production in America

DISTRIBUTORS

Northeast: Educational Film Library, Syracuse University, Syracuse 10, N. Y.

Southeast: Vocational Film Library, Department of Agricultural Education North Carolina State College, Raleigh, North Carolina.

Lower Mississippi Valley and Southwest: Bureau of Film Service, Department of Educational Extension, Oklahoma A & M College, Stillwater, Oklahoma.

Midwest: Visual Aid Service, University Extension, University of Illinois, Champaign, Illinois.

West: Department of Visual Education, University of California, Berkeley 4, California.

Department of Visual Education, University of California Extension, 405 Hilgard Ave., Los Angeles 24, California.

Department of Visual Instruction, Oregon State College, Corvallis, Oregon.

Bureau of Visual Teaching, State College of Washington, Pullman, Washington.

Canada: National Film Board, Ottawa, Ontario.

For the Province of Ontario: Distribution Services, Ontario Agricultural College, Guelph, Ontario.

IMPORTANT

Requests should be made well in advance and should include information as to group before which the film is to be shown, date of exhibition (alternative dates if possible), and period of loan.

Request bookings from your nearest distributor.

AVAILABLE LITERATURE

The following literature on the use of fertilizers in profitable soil and crop management is available for distribution. We shall be glad to send these upon request and in reasonable amounts as long as our supply lasts.

Reprints

28-12-45 Better Corn (Midwest) (Circular)
F-3-40 When Fertilizing, Consider Plant-food Content of Crops
S-5-40 What is the Matter with Your Soil?
Y-5-43 Value & Limitations of Methods of Diagnosing Plant Nutrient Needs
A-1-44 What's in That Fertilizer Bag?
P-3-45 Balanced Fertility in the Orchard
Z-5-45 Alfalfa—The Aristocrat
OO-8-45 Potash Fertilizers Are Needed on Many Midwestern Farms
ZZ-11-45 First Things First in Soil Fertility
T-4-46 Potash Losses on the Dairy Farm
Y-5-46 Learn Hunger Signs of Crops
TT-11-47 How Different Plant Nutrients Influence Plant Growth
VV-11-47 Are You Pasture Conscious?
X-6-48 Applying Fertilizers in Solution
AA-6-48 The Chemical Composition of Agricultural Potash Salts
GG-10-48 Starved Plants Show Their Hunger
SS-12-49 Fertilizing Vegetable Crops
BB-8-50 Trends in Soil Management of Peach Orchards
X-8-51 Orchard Fertilization Ground and Foliage
BB-10-51 Healthy Plants Must Be Well Nourished
II-12-51 Pasture Improvement With 10-10-10 Fertilizer
KK-12-51 Potassium in Animal Nutrition
A-1-52 Research Points the Way to Higher Levels of Peanut Production
Y-10-52 The Nutrition of Muck Crops
CC-12-52 The Leaf Analysis Approach to Crop Nutrition
I-2-53 Sericea Is a Good Drought Crop
J-3-53 Balanced Nutrition Improves Winter Wheat Root Survival
K-3-53 Kudzu Keeps Growing During Droughts
N-4-53 Coastal Bermuda—A Triple-threat Grass on the Cattleman's Team
P-4-53 Learning How to Make Profits from Sweet Potatoes
T-5-53 Trefoil Is Different
W-6-53 The Development of the American Potash Industry
DD-10-53 Sampling Soils for Chemical Tests
II-11-53 The Importance of Legumes in Dairy Pastures
JJ-11-53 Boron—Important to Crops
MM-12-53 White Birch Helps Restore Potash-Deficient Forest Soils
K-2-54 Soil and Plant Analysis Increase Fertilizer Efficiency
R-3-54 Soil Fertility (Basis for High Crop Production)
U-4-54 Nutrient Balance Affects Corn Yield and Stalk Strength
CC-6-54 Fertility Increases Efficiency of Soil Moisture
EE-8-54 Red Apples Require Balanced Nutrition
FF-8-54 Apply Fertilizers in Fall For Old Alfalfa, Grass Pasture and Timothy-Brome Fields
GG-8-54 Effect of Boron on Beets and Crops Which Follow
JJ-10-54 Principles Involved in Soil Testing
LL-10-54 Relation of Fertilizer to Quality and Yield of Flue-cured Tobacco
MM-10-54 Longer Life for Ladino
SS-11-54 Foliar Application of Plant Nutrients to Vegetable Crops
VV-12-54 Potassium Affects Growth of Stocks
YY-12-54 Physical Condition of the Soil Affects Fertilizer Utilization
A-1-55 Potash-Deficiency Symptoms
C-1-55 Summary of Ten Years' Work with Complete Fertilizers on Sugar Cane
D-1-55 Nitrogen Use Accentuates Need for Minerals
E-1-55 Guides to the Management of Illinois Soils
F-1-55 The Soil Profile's Contribution to Plant Growth
G-2-55 Seven Steps to Good Cotton
H-2-55 Apparent Fertility Trends in Western Irrigated Soils
I-2-55 Shortages of Potash Limit Grape Yields
L-3-55 Soybean Production in the Southern States
N-3-55 The Pacemaker Club Grows More Corn
P-3-55 N-P-K for Deciduous Fruit Trees
Q-3-55 Soil Testing Moves Ahead in Arkansas
R-4-55 Potash Prevents "Curl Leaf" of Sour Cherries
S-4-55 Greener Pastures Mean Better Living
T-4-55 Leaf Analysis Reveals Potash Need in Southern Oregon
U-4-55 Fertilizer Recommendations—Burley Tobacco
V-4-55 Planned Nutrition for Canning Tomatoes
W-5-55 The Production of Sugar Beets on Organic Soils
X-5-55 What Is Happening to Our Citrus Soils?
Y-5-55 Pasture Improvement Through Renovation
Z-5-55 Azalea Fertilization
AA-5-55 Soil Improvement Pays in Large Figures
BB-8-55 Residual Fertility Insures Alfalfa After Drouth
CC-8-55 Plan Before You Fertilize
DD-8-55 A Good Summer Grass Team
EE-10-55 Fertilizing For Better Apples
FF-10-55 Sod Seeding Improves Pastures
GG-10-55 Improved Water-disposal Systems
HH-10-55 Fertilizers Will Cut Production Costs
II-11-55 More Efficient Fertilizer Use by New England Farmers
JJ-11-55 A New Day in Peanut Production

THE AMERICAN POTASH INSTITUTE

1102 16th STREET, N. W. WASHINGTON 6, D. C.

The old Swedish lumber jack came into town on one of his rare visits and headed directly to his favorite tavern—

"Bartender" he shouted, "Ay vant some squirrel whiskey."

"We don't have any squirrel whiskey," the bartender answered, "But I can give you some 'Old Crow'."

"Naw" answered the Swede, "Ay don't want to fly, ay just want to jump around a leetle."

* * *

First bride: "Does your husband snore in his sleep?"

Second: "I don't know, we've only been married four days."

* * *

A flying rancher landed his plane on a field near Denver, got out, and said to a well-dressed man standing nearby, "Say bud, keep an eye on my machine, will you?"

The man replied, "Say, I'll have you know I'm a U. S. Senator."

"Well, what if you are," said the rancher, "I'll trust you!"

* * *

She (out riding)—"I want it understood that there's to be no love making."

He—"Oh."

She—"Now that's understood, where shall we go?"

He—"Home."

All this talk of astronomical-scaled saving reminds us of the thrifty old Yankee's comment when told that a certain industrial tycoon had left a fortune upward of $100 million.

"One hundred million dollars?" was the awed rejoinder. "My, he must have had an awful savin' woman."

* * *

First old maid: "What kind of time did you have in New York?"

Second old maid: "Eastern standard time."

* * *

"I can't get my report card back," the boy explained to his teacher. "You gave me an A in something and they're still mailing it to relatives."

* * *

Reporter to pa on his 105th birthday: "What is your opinion of modern women?"

Pa: "Son, I quit thinking about women two years ago."

* * *

The bride's mother was weeping copiously, and her husband was trying to comfort her, "Now, dear, remember—instead of losing a daughter, we're getting another son."

"Oh, goodness, no!" the distressed mother shrieked. "At my age, who wants more children."

To Increase Profits...

Give crops needed Boron!

Give your crops needed Boron...
with Borated Fertilizers
Yields up to 2½ times greater!
FERTILIZER BORATES or COLEMANITE
PACIFIC COAST BORAX CO.

3 TYPES OF BORATES... TO CORRECT AND PREVENT BORON DEFICIENCY!

SOLUBLE
SLOWLY SOLUBLE
HIGHLY SOLUBLE

Write for this Poster— of interest to everyone connected in any way with improving agriculture.

SOLUBLE

FERTILIZER BORATE

A sodium borate ore concentrate rich in boron—offers the most economical source of boron for agriculture. This material is suitable for BORATING fertilizers or for use as dry application direct to soil. Fertilizer Borate is offered in two grades with choice of coarse or fine mesh. High Grade contains 44% B_2O_3. Regular contains 34% B_2O_3. Send for Bulletin PF-3.

SLOWLY SOLUBLE

COLEMANITE
HIGH GRADE

A natural calcium borate mineral. This slowly soluble lime borate is offered for conditions where soils are light and porous, or in regions of high rainfall. The slow and extended release of available boron by Colemanite as it weathers is advantageous to cotton and boron-sensitive crops which do require boron. Content in B_2O_3 ranges from 32% to 35%. Send for Bulletin PF-2.

HIGHLY SOLUBLE

POLYBOR-2

Contains a higher percentage of available boron than any comparable agricultural borate on the market . . . 20.5% Boron or 66% B_2O_3. This material should be applied as a spray or dust, directly to the foliage of crops. Polybor-2 is compatible with insecticides and fungicides currently in use and may be applied in the same solutions in the established routine culture of crops. Send for Bulletin PF-4.

Write today for Bulletins:

AUBURN, ALABAMA — 1st National Bank Building
PORTLAND, OREGON — 1304 N.W. Johnson Street
HOUSTON, TEXAS — 1503 Hadley Street
CALGARY, ALTA., CANADA — 2031 Fortieth Ave., S.W.

PACIFIC COAST BORAX CO.
DIVISION OF BORAX CONSOLIDATED, LIMITED
630 SHATTO PLACE, LOS ANGELES, CALIF. • 100 PARK AVE., NEW YORK CITY

MANUFACTURERS OF FAMOUS "20 MULE TEAM" PACKAGE PRODUCTS

Better Crops
with PLANT FOOD

IF NOT DELIVERED, return to
AMERICAN POTASH INSTITUTE, INC.
1102—16th St., N. W., Washington 6, D. C.
RETURN POSTAGE GUARANTEED

Bulk Rate
U. S. POSTAGE
PAID
Washington, D. C.
Permit No. 2283

THE POCKET BOOK OF AGRICULTURE